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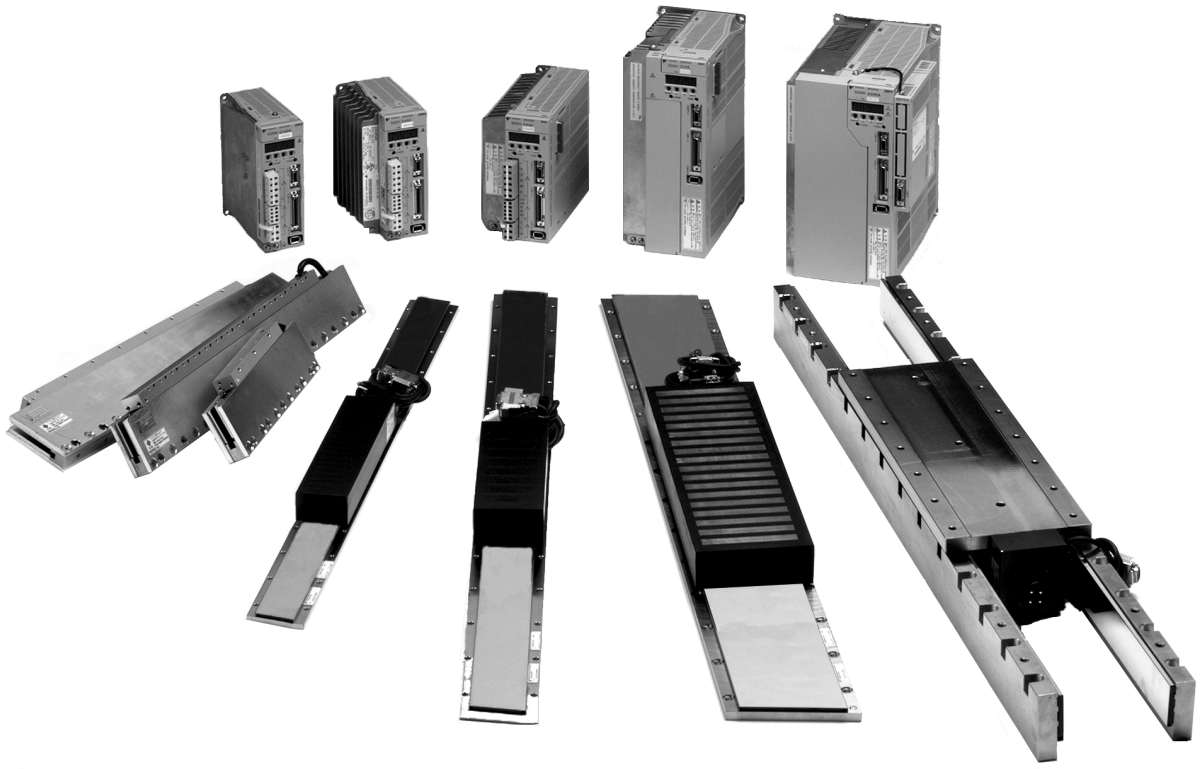

Σ-II Series

SGDH User's Manual Supplement for Linear Sigma Series

Upon receipt of the product and prior to initial operation, read these instructions thoroughly, and retain for future reference.

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⚠ WARNING

YASKAWA manufactures component parts that can be used in a wide variety of industrial applications. The selection and application of YASKAWA products remain the responsibility of the equipment designer or end user. YASKAWA accepts no responsibility for the way its products are incorporated into the final system design.

Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user.

YASKAWA offers an express warranty only as to the quality of its products in conforming to standards and specifications published in YASKAWA's manual. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS OFFERED. YASKAWA assumes no liability for any personal injury, property damage, losses, or claims arising from misapplication of its products.

This manual deals with the stand-alone installation, wiring, test run, etc., of a unified linear/rotary-type AC servomotor. See the following manual for other items.

- Sigma II Series Servo System Users Manual (YEA-SIA-S800-32.2)

About this Manual

■ Intended Audience

This manual is intended for the following users.

- Those selecting Σ-II Series servodrives or peripheral devices for Σ-II Series servodrives.
- Those wanting to know about the ratings and characteristics of Σ-II Series servodrives.
- Those designing Σ-II Series servodrive systems.
- Those installing or wiring Σ-II Series servodrives.
- Those performing trial operation or adjustments of Σ-II Series servodrives.
- Those maintaining or inspecting Σ-II Series servodrives.

■ Description of Technical Terms

The terms in this manual are defined as follows:

- Servomotor or motor = Linear Σ Series SGLGW, SGLFW and SGLTW linear servomotor
- SERVOPACK = Σ-II Series SGDH amplifier.
- Servodrive = A set including a servomotor and servo amplifier.
- Servo System = A servo control system that includes the combination of a servodrive with a host computer and peripheral devices.
- Parameter number = Numbers that the user inputs toward the SERVOPACK.

■ Indication of Reverse Signals

In this manual, the names of reverse signals (ones that are valid when low) are written with a forward slash (/) before the signal name, as shown in the following example:

- $\overline{\text{S-ON}}$ = /S-ON
- $\overline{\text{P-CON}}$ = /P-CON

Safety Information

The following conventions are used to indicate precautions in this manual. Failure to heed precautions provided in this manual can result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.

⚠ WARNING — Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.

⚠ CAUTION — Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

In some situations, the precautions indicated could have serious consequences if not heeded.

PROHIBITED — Indicates prohibited actions that must not be performed. For example, this symbol would be used as follows to indicate that fire is prohibited: .

MANDATORY — Indicates compulsory actions that must be performed. For example, this symbol would be used as follows to indicate that grounding is compulsory: .

The warning symbols for ISO and JIS standards are different, as shown below.

ISO	JIS

The ISO symbol is used in this manual.

Both of these symbols appear on warning labels on Yaskawa products. Please abide by these warning labels regardless of which symbol is used.

Notes for Safe Operation

Read this manual thoroughly before checking products on delivery, storage and transportation, installation, wiring, operation and inspection, and disposal of the AC servodrive.

⚠ WARNING

- If you have a pacemaker or any other electronic medical device, do not go near the magnetic way of the linear servomotor.
  Failure to observe this warning may result in the malfunction of the medical device.
- Be sure to use nonmagnetic tools when installing or working close to the linear servomotor. (Example: a beryllium-copper alloy hexagonal wrench set, made by NGK Insulators, Ltd.)
- If starting an operation with the linear servomotor in a machine, set the linear servomotor to always allow emergency stops.
  Failure to observe this warning may result in injury.
- Never touch the linear servomotor or machinery during operation.
  Failure to observe this warning may result in injury.
- Before wiring, install the SERVOPACK and the linear servomotor.
  Failure to observe this warning may result in electric shock.
- Do not operate switches with wet hands.
  Failure to observe this warning may result in electric shock.
- Never touch the inside of the SERVOPACKs.
  Failure to observe this warning may result in electric shock.
- Do not touch terminals for five minutes after the power is turned OFF.
  Residual voltage may cause electric shock.
- Do not touch terminals for five minutes after voltage resistance test.
  Residual voltage may cause electric shock.
- Make sure that the main circuit power cable, the control power cable, and the linear servomotor main circuit cable are wired correctly.
  Failure to observe this warning may result in damage to the SERVOPACK.
- Follow the procedures and instructions for trial operation precisely as described in this manual.
  Malfunctions that occur after the servomotor is connected to the equipment not only damage the equipment, but may also cause an accident resulting in death or injury.
- The SGDH SERVOPACK supports both AC and DC power. If DC power is supplied to the SERVOPACK without setting Pn001=n□1□□ (DC power input), the internal components of the SERVOPACK will burn and may result in fire or serious damage.
  Before using a DC power supply, be sure to check the parameter Pn001 setting.
- Do not remove the front cover, cables, connectors, or optional items while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not damage, press, exert excessive force or place heavy objects on the cables.
  Failure to observe this warning may result in electric shock, stopping operation of the product, or burning.

⚠ WARNING

- Provide an appropriate stopping device on the machine side to ensure safety. A holding brake for a servomotor with brake is not a stopping device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting momentary power loss to avoid an unexpected restart. Take appropriate measures to ensure safety against an unexpected restart.
  Failure to observe this warning may result in injury.

- Connect the ground terminal to electrical codes (ground resistance: 100 Ω or less).
  Improper grounding may result in electric shock or fire.

- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this warning may result in electric shock or injury.

- Do not modify the product.
  Failure to observe this warning may result in injury or damage to the product.

■ Checking on Delivery

⚠ CAUTION

- Always use the linear servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.

■ Storage and Transportation

⚠ CAUTION

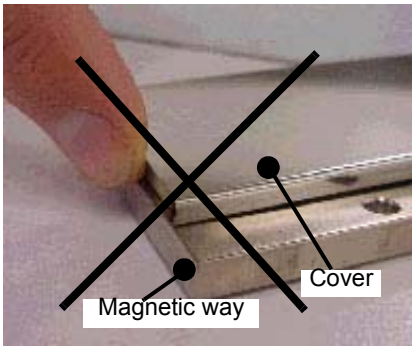
- Do not store or install the product in the following places.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the storage or installation temperature conditions.
  - Locations subject to humidity outside the range specified in the storage or installation humidity conditions.
  - Locations subject to condensation as the result of extreme changes in temperature.
  - Locations subject to corrosive or flammable gases.
  - Locations subject to dust, salts, or iron dust.
  - Locations subject to exposure to water, oil, or chemicals.
  - Locations subject to shock or vibration.

  Failure to observe this caution may result in fire, electric shock, or damage to the product.
- Do not carry the linear servomotor by its cables.
  Failure to observe this caution may result in injury or malfunction.
- Do not place any load exceeding the limit specified on the packing box.
  Failure to observe this caution may result in injury or malfunction.

■ Installation

⚠ CAUTION

- When unpacking and installing magnetic way, check that no metal fragments or magnetized objects near the stator because they may be affected by the magnetic attraction of the magnetic way.
  Failure to observe this caution may result in injury or damage to the magnetic way's magnets.
- Do not use the magnetic way near metal or other magnetized objects.
  Failure to observe this caution may result in injury.
- Do not place clocks, magnetic cards, floppy disks, or measuring instruments close to the magnetic way.
  Failure to observe this caution may result in malfunction or damage to these items by the magnetic force.
- Securely mount the linear servomotor on to the machine.
  If the linear servomotor is not mounted securely, it may loosen during operation.
- Do not carry the magnetic way by its antimagnetic cover.
  Failure to observe this caution may result in injury by the cover's edge or the shape of the cover may become distorted.



- Install SERVOPACKs, linear servomotors, and regenerative resistors on nonflammable objects.
  Mounting directly onto or near flammable objects may result in fire.
- Never use the products in an environment subject to water, corrosive gases, inflammable gases, or combustibles.
  Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.
  Failure to observe this caution may result in injury.
- Do not cover the inlet or outlet parts and prevent any foreign objects from entering the product.
  Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.
  Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.
  Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.
  Failure to observe this caution may result in malfunction.

■ Wiring

⚠ CAUTION

- Securely tighten the cable connector screws and securing mechanism.
  If the connector screws and securing mechanism are not secure, they may loosen during operation.
- Use power lines and cables with a radius, heat resistance, and flexibility suitable for the system.
- If the SERVOPACK malfunctions, turn OFF the main circuit's power supply of the SERVOPACK.
  The continuous flow of a large current may cause fire.
- Use a noise filter to minimize the effects of electromagnetic damage.
  Failure to observe this caution may result in electromagnetic damage to electronic devices used near the SERVOPACK.
- Do not connect a three-phase power supply to the U, V, or W output terminals.
  Failure to observe this caution may result in injury or fire.
- Securely connect the power supply terminals and motor output terminals.
  Failure to observe this caution may result in fire.
- Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 30 cm (11.81 in).
  Failure to observe this caution may result in malfunction.
- Use shielded twisted-pair wire or shielded multi-core twisted-pair wire for the signal lines and feedback lines of the serial converter unit (SC).
  The maximum wiring length is 3 m for the reference input line and 20 m for the SC feedback line.
- Do not touch the power terminals for five minutes after turning power OFF because high voltage may still remain in the SERVOPACK.
  Make sure the charge indicator is turned OFF first before starting an inspection.
- Avoid frequently turning power ON and OFF. Do not turn power ON or OFF more than once per minute.
  Since the SERVOPACK has a capacitor in the power supply, a high charging current flows for 0.2 seconds when power is turned ON. Frequently turning power ON and OFF causes main power devices such as capacitors and fuses to deteriorate, resulting in unexpected problems.
- Observe the following precautions when wiring main circuit terminal blocks.
  - Remove the terminal block from the SERVOPACK prior to wiring.
  - Insert only one wire per terminal on the terminal block.
  - Make sure that the core wire is not electrically shorted to adjacent core wires.
- Do not connect the SERVOPACK for 100 V and 200 V directly to a voltage of 400 V.
  The SERVOPACK will be destroyed.
- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Always use the specified power supply voltage.
  An incorrect voltage may result in burning.
- Make sure that the polarity is correct.
  Incorrect polarity may cause ruptures or damage.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
  An incorrect power supply may result in damage to the product.

⚠ CAUTION

- Install external breakers or other safety devices against short-circuiting in external wiring.
  Failure to observe this caution may result in fire.
- Take appropriate and sufficient countermeasures for each when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations subject to possible exposure to radioactivity.
  - Locations close to power supplies including power supply lines.

  Failure to observe this caution may result in damage to the product.

■ Operation

⚠ CAUTION

- Do not stand within the machine's range of motion during operation.
  Failure to observe this caution may result in injury.
- Before operation, install a limit switch or stopper on the end of the slider to prevent unexpected movement.
  Failure to observe this caution may result in injury.
- Before starting operation with a machine connected, change the settings to match the parameters of the machine.
  Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective during zero point search mode using parameter Fn003.
- If using the linear servomotor on a vertical axis, install a safety device such as a counterbalance so that the workpiece does not fall if an alarm or overtravel occurs.
  The workpiece may fall during overtraveling.
- When not using the normal autotuning, set to the correct mass ratio.
  Setting to an incorrect moment of inertia ratio may cause vibration.
- Do not touch the SERVOPACK heatsinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.
  Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
  Failure to observe this caution may result in injury due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
  Failure to observe this caution may result in injury.

■ Maintenance and Inspection

⚠ CAUTION

- When replacing the SERVOPACK, transfer the previous SERVOPACK parameters to the new SERVOPACK before resuming operation.
  Failure to observe this caution may result in damage to the product.
- Do not attempt to change wiring while the power is ON.
  Failure to observe this caution may result in electric shock or injury.

- Do not disassemble the linear servomotor.
  Failure to observe this caution may result in electric shock or injury.

■ Disposal

⚠ CAUTION

- When disposing of the products, treat them as ordinary industrial waste.

■ General Precautions

Note the following to ensure safe application.

- The drawings presented in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- This manual is subject to change due to product improvement, specification modification, and manual improvement. When this manual is revised, the manual code is updated and the new manual is published as a next edition.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.
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1

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1.1 Checking Products

1.1.1 Check Items

Check the following items when the products are delivered.

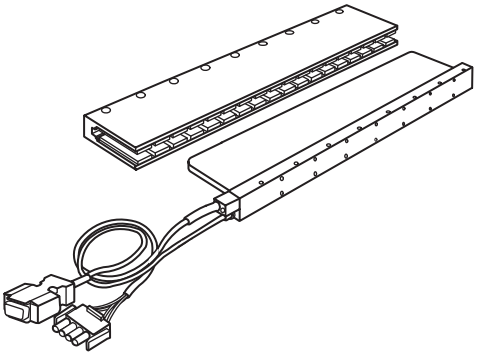
Check Items	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates on the linear servomotor and SERVOPACK. (Refer to the descriptions of model numbers in the following section.)
Is there any damage?	Check the overall appearance, and check for damage or scratches that may have occurred during shipping.

If any of the above items are faulty or incorrect, contact your Yaskawa representative or the dealer from whom you purchased the products.

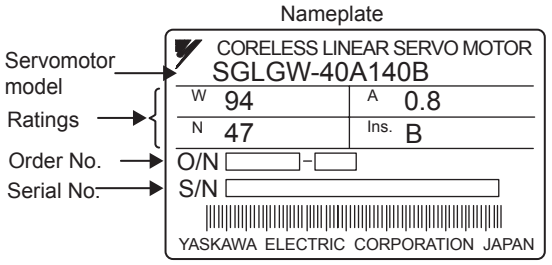
1.1.2 Linear Servomotors

The location of the nameplate varies depending on the model of the linear servomotor. The nameplate is affixed on both the coil assembly and the magnetic way.

(1) Coreless SGLGW and SGLGM Linear Servomotors

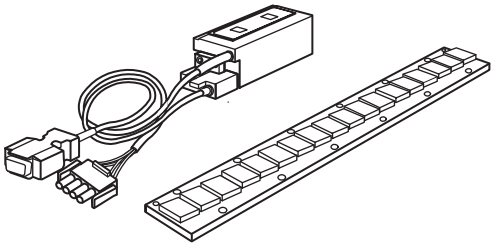


• Coil assembly and Magnetic way



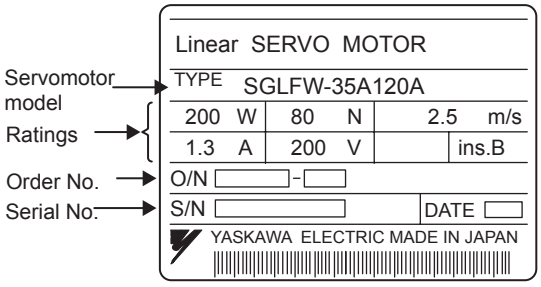
(2) SGLFW and SGLFM Linear Servomotors with F-type Iron Core and SGLTW and SGLTM Linear Servomotors with T-type Iron Core

• SGLFW and SGLFM

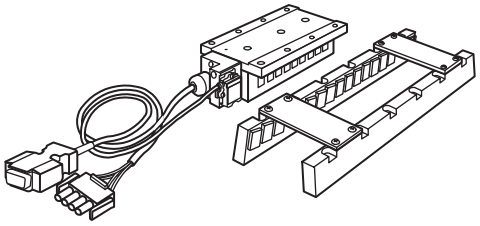


• Coil assembly

Nameplate

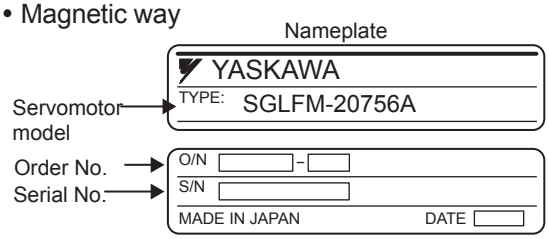


• SGLTW and SGLTM



• Magnetic way

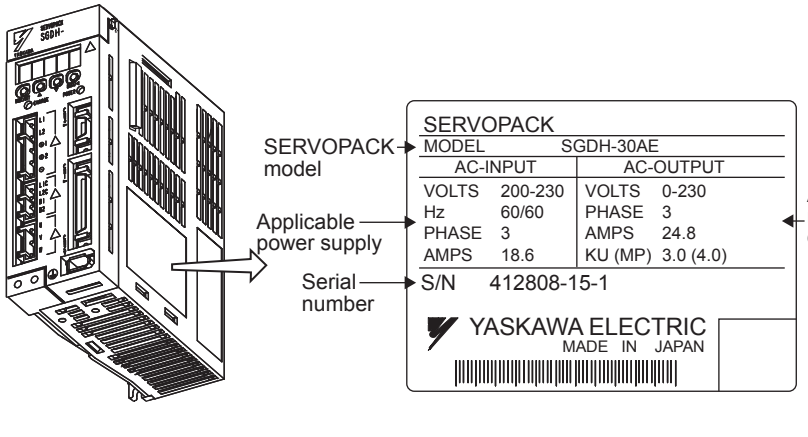
Nameplate



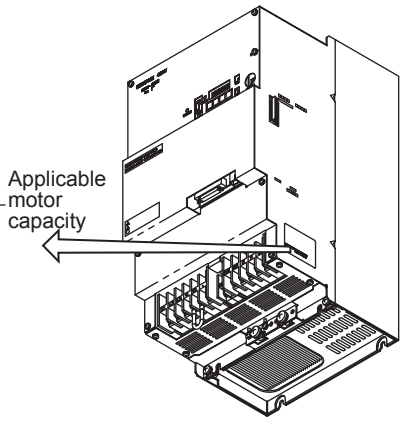
Note: The location of the nameplate varies depending on the model and capacity of the linear servomotor.

1.1.3 SERVOPACKs

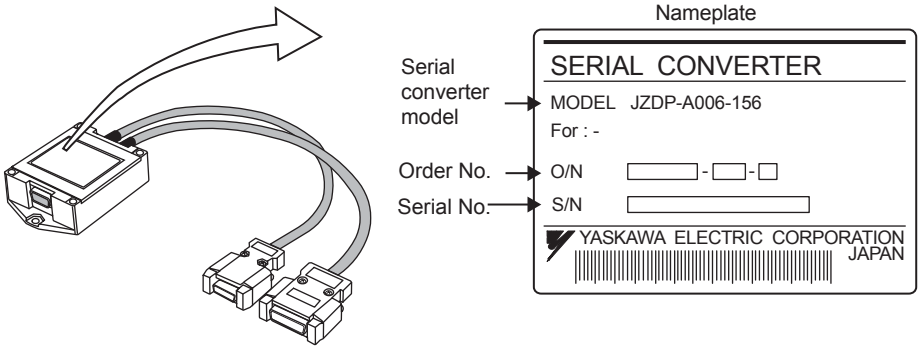
• SGDH for 30 W to 5.0 kW



• SGDH for 7.5 kW



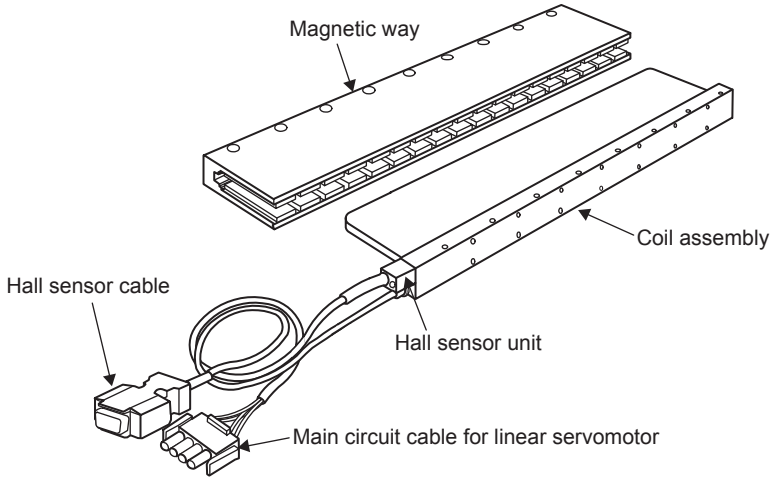
1.1.4 Serial Converter Units



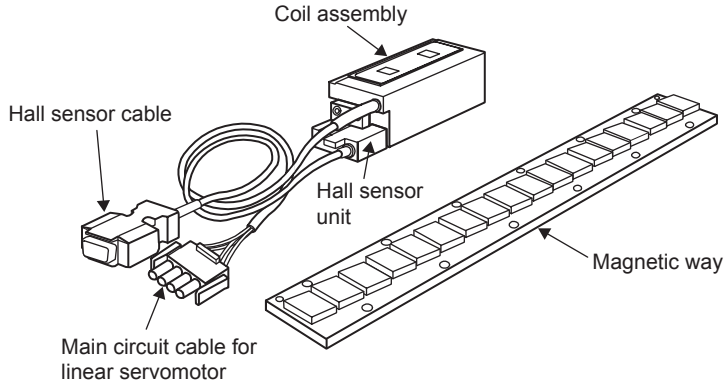
1.2 Product Part Names

1.2.1 Linear Servomotors

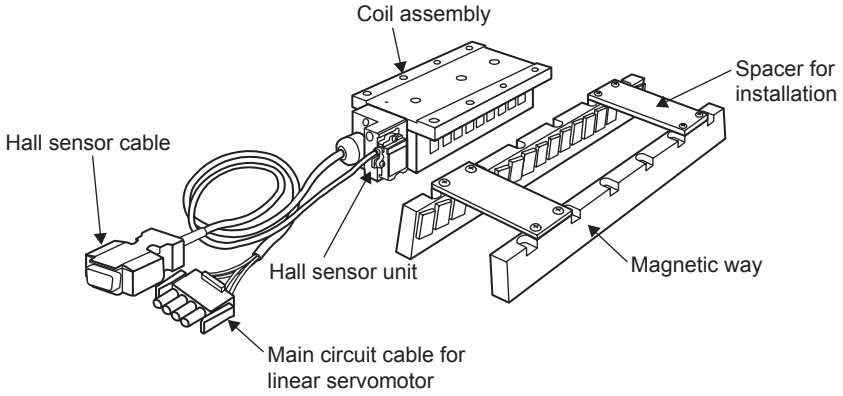
(1) Coreless SGLGW and SGLGM



(2) SGLFW and SGLFM With F-type Iron Core

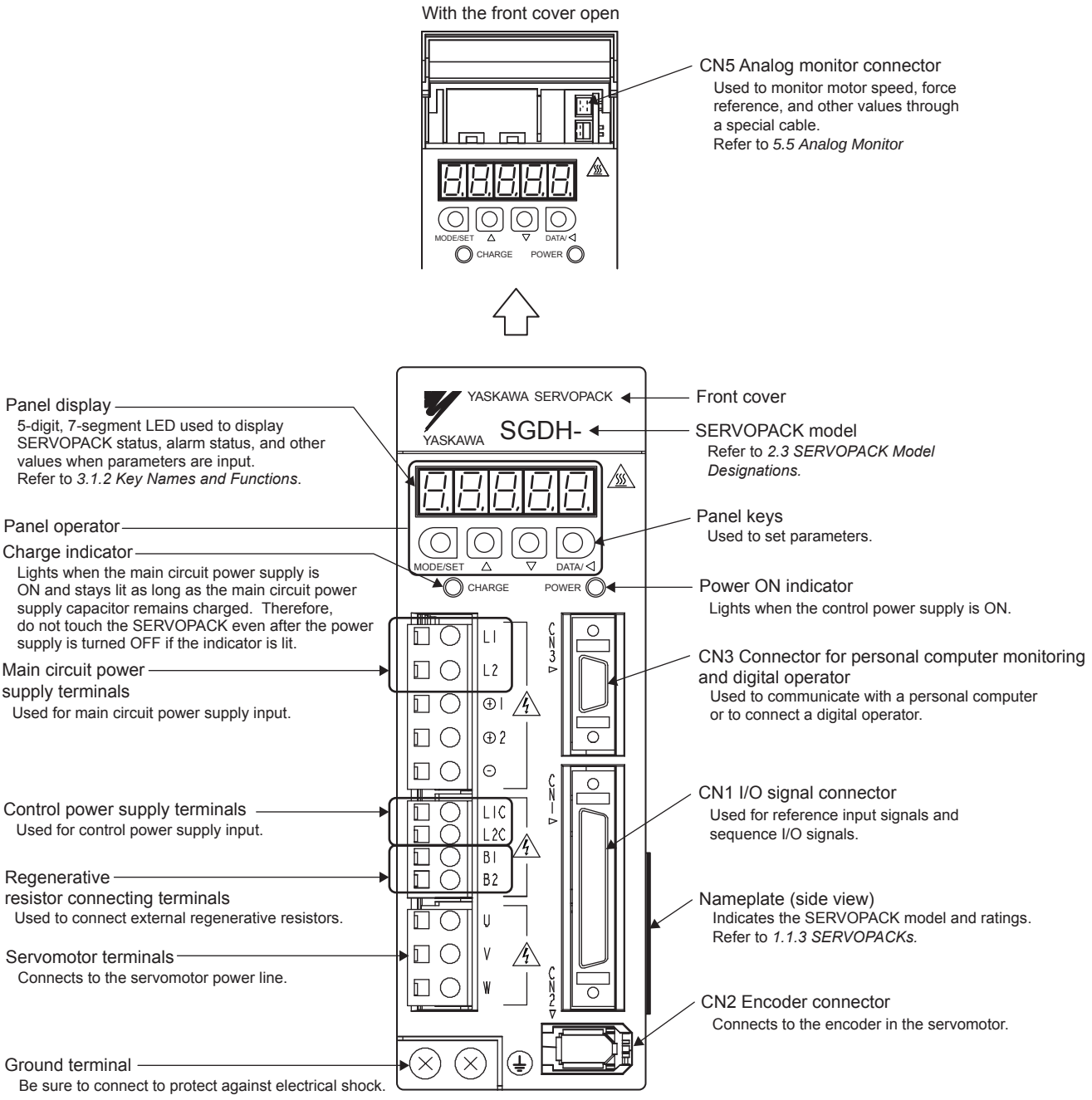


(3) SGLTW and SGLTM With T-type Iron Core

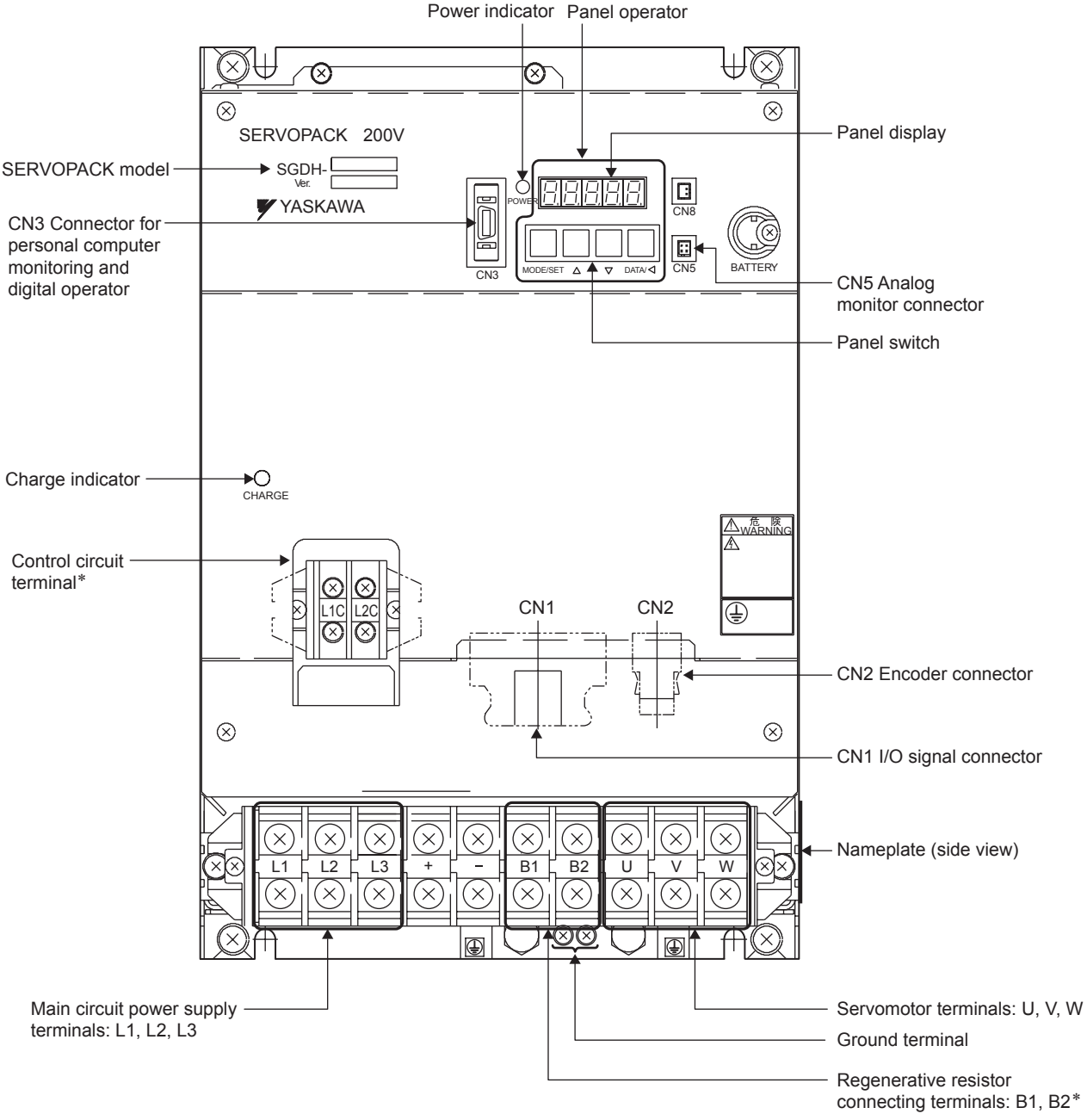


1.2.2 SERVOPACKs

(1) SGDH for 50 W to 5.0 kW


With the front cover open
CN5 Analog monitor connector
Used to monitor motor speed, force reference, and other values through a special cable.
Refer to 5.5 Analog Monitor
MODE/SET
DATA/
CHARGE
POWER
YASKAWA SERVOPACK
YASKAWA
SGDH-
Front cover
SERVOPACK model
Refer to 2.3 SERVOPACK Model Designations.
Panel display
5-digit, 7-segment LED used to display SERVOPACK status, alarm status, and other values when parameters are input.
Refer to 3.1.2 Key Names and Functions.
Panel operator
Panel keys
Used to set parameters.
Charge indicator
Lights when the main circuit power supply is ON and stays lit as long as the main circuit power supply capacitor remains charged. Therefore, do not touch the SERVOPACK even after the power supply is turned OFF if the indicator is lit.
Power ON indicator
Lights when the control power supply is ON.
L1
L2
⊕1
⊕2
⊖
Main circuit power supply terminals
Used for main circuit power supply input.
CN3
CN3 Connector for personal computer monitoring and digital operator
Used to communicate with a personal computer or to connect a digital operator.
CN1
L1C
L2C
B1
B2
Control power supply terminals
Used for control power supply input.
CN1 I/O signal connector
Used for reference input signals and sequence I/O signals.
Regenerative resistor connecting terminals
Used to connect external regenerative resistors.
Nameplate (side view)
Indicates the SERVOPACK model and ratings.
Refer to 1.1.3 SERVOPACKs.
U
V
W
Servomotor terminals
Connects to the servomotor power line.
CN2
CN2 Encoder connector
Connects to the encoder in the servomotor.
Ground terminal
Be sure to connect to protect against electrical shock.

(2) SGDH for 7.5 kW

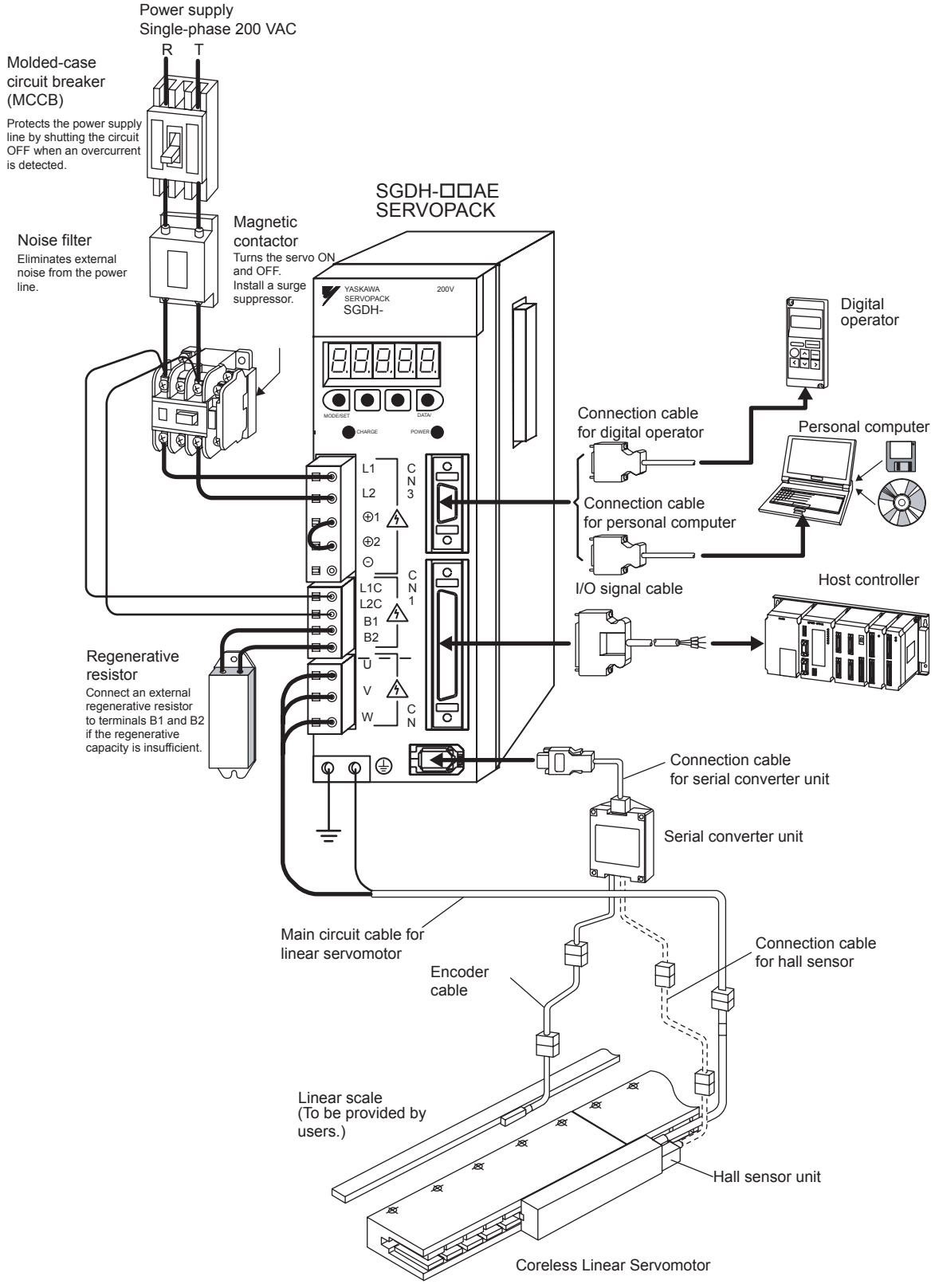


* Control circuit terminal and regenerative resistor connecting terminals differ the position of the terminal block by the SERVOPACK model.

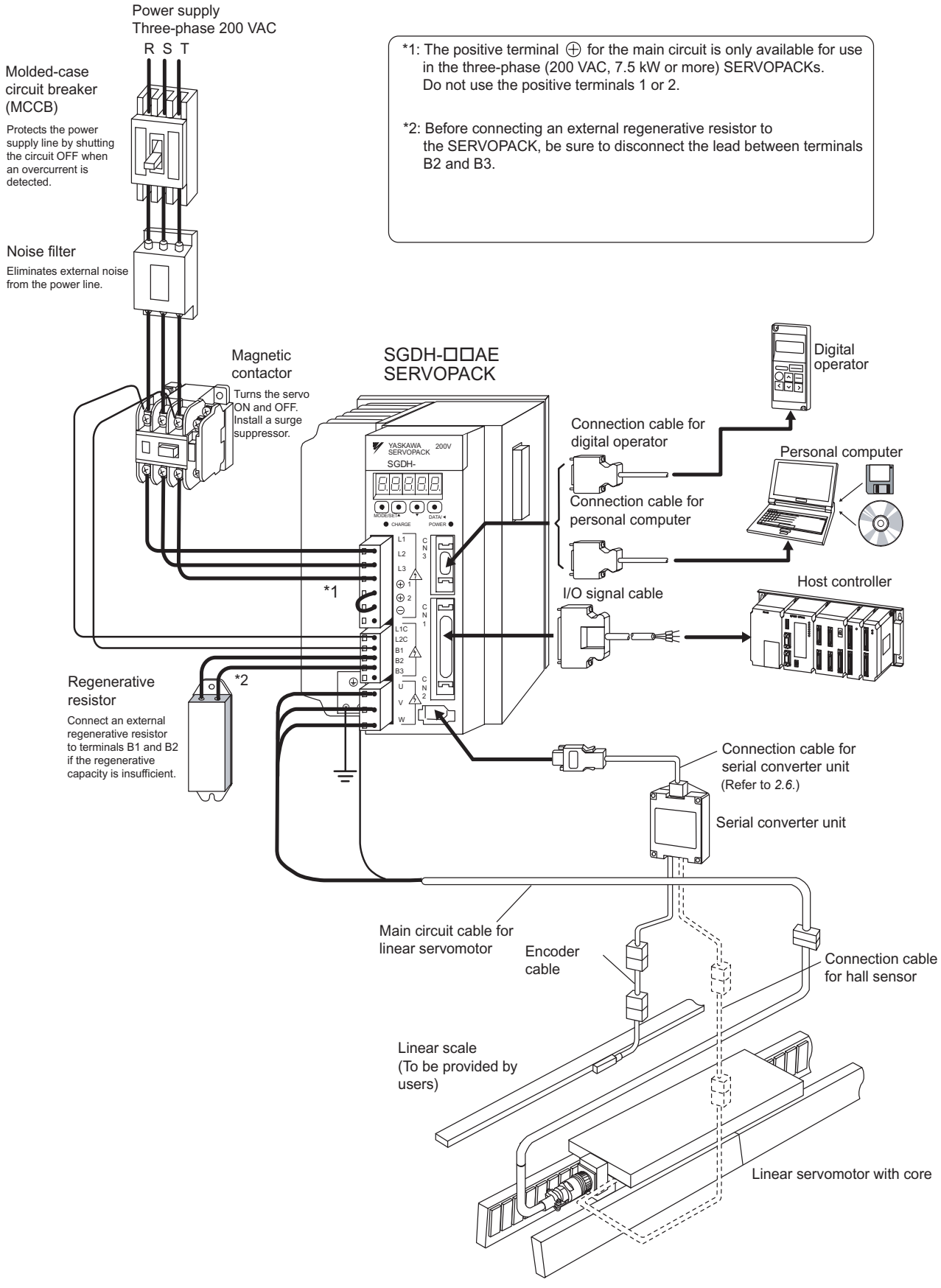
1.3 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

1.3.1 Single-phase, 200 V Main Circuit



1.3.2 Three-phase, 200 V Main Circuit


Power supply
Three-phase 200 VAC
R S T
Molded-case circuit breaker (MCCB)
Protects the power supply line by shutting the circuit OFF when an overcurrent is detected.
Noise filter
Eliminates external noise from the power line.
Magnetic contactor
Turns the servo ON and OFF. Install a surge suppressor.
SGDH-□□AE SERVOPACK
*1: The positive terminal ⊕ for the main circuit is only available for use in the three-phase (200 VAC, 7.5 kW or more) SERVOPACKs. Do not use the positive terminals 1 or 2.
*2: Before connecting an external regenerative resistor to the SERVOPACK, be sure to disconnect the lead between terminals B2 and B3.
Digital operator
Connection cable for digital operator
Personal computer
Connection cable for personal computer
Host controller
I/O signal cable
*1
*2
Regenerative resistor
Connect an external regenerative resistor to terminals B1 and B2 if the regenerative capacity is insufficient.
Connection cable for serial converter unit (Refer to 2.6.)
Serial converter unit
Main circuit cable for linear servomotor
Encoder cable
Connection cable for hall sensor
Linear scale (To be provided by users)
Linear servomotor with core

1.4 Applicable Standards

Σ-II Series servodrives conform to the following overseas standards.

1.4.1 North American Safety Standards (UL, CSA)

Model		UL*1 Standards (UL File No.)	CSA*2 Standards	Certifications
SERVOPACK	• SGDH	UL508C(E147823)	CSA C22.2 No.14	UL

* 1. Underwriters Laboratories Inc.
* 2. Canadian Standards Association.

1.4.2 CE Marking

Model		Low Voltage Directive	EMC Directive		Certifications
			EMI	EMS	
SERVOPACK	• SGDH	EN50178	EN55011 class A group 1	EN50082-2 or EN61000-6-2	TÜV PS*

* TÜV Product Services GmbH

Because SERVOPACKs and linear servomotors are built-in type, reconfirmation is required after being installed in the final product.

2

Selections

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2.1 Linear Servomotor Model Designation

This section describes how to check the model and ratings of the linear servomotor. The alphanumeric codes after SGL□□ - indicate the specifications.

2.1.1 Coil Assembly

SGL G W − 40 A 140 A P

Linear Σ Series
Linear servomotor

Servomotor Model	
Code	Specifications
G	Coreless
F	F-type iron core
T	T-type iron core

W : Coil assembly

Magnet height

Voltage
A : 200 VAC

Design revision order
A,B,C

Options	
Code	Specifications
P	With hall sensor
W	With hall sensor & serial converter

Length of coil assembly

2.1.2 Magnetic Way

SGL G M − 40 225 A C

Linear Σ Series
Linear servomotor

Model	
Code	Specifications
G	Coreless
F	F-type iron core
T	T-type iron core

M : Magnetic way

Magnet width

Length of magnetic way

Design revision order
A,B,C

Options		
Code	Specifications	Remarks
C	With magnet cover	Only for linear servomotors with F-type iron core
Y	With base and magnet covers	Only for linear servomotors with T-type iron core

2.2 SERVOPACK Model Designation

Select the SERVOPACK according to the applied linear servomotor.

SGDH - 10 A E □

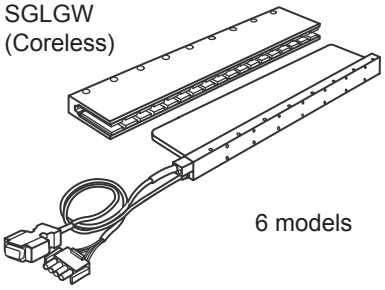
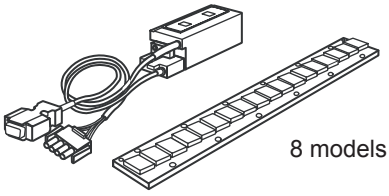
Rated Output of Applicable Servomotor (kW)			
Code	Rated Output	Code	Rated Output
A5	0.05	10	1.0
01	0.10	15	1.5
02	0.20	20	2.0
04	0.40	30	3.0
05	0.45	50	5.0
08	0.75	75	7.5

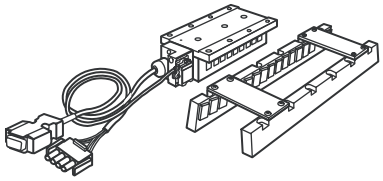
Mounting Method		
Code	Specifications	Rated Output of Applicable Servomotor (kW)
-	Base-mounted	0.05 to 7.5

Power Supply Voltage	
Code	Voltage
A	Single/Three-phase, 200V
D	Three-phase, 400V

Model (Fixed)	
Code	Remarks
E	・For force, speed, and position control ・Applicable for various application modules

2.3 Σ-II Series SERVOPACKs and Applicable Linear Servomotors

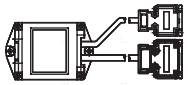
Linear Series Linear Servomotor		Σ-II Series SGDH SERVOPACK	
		Single-phase 200 VAC	Three-phase 200 VAC
SGLGW (Coreless)  6 models	40A140B	01AE	
	40A253B	02AE	
	40A365B	04AE	
	60A140B	02AE	
	60A253B	04AE	
	60A365B	08AE-S	08AE
SGLFW (With F-type iron core)  8 models	20A090A	02AE	
	20A120A	02AE	
	35A120A	02AE	
	35A230A		05AE
	50A200A	08AE-S	08AE
	50A380A	15AE-S	15AE
	1ZA200A	15AE-S	15AE
	1ZA380A		20AE

Linear Σ Series Linear Servomotor		Σ-II Series SGDH SERVOPACK	
		Single-phase 200 VAC	Three-phase 200 VAC
SGLTW (With T-type iron core)  10 models	20A170A		05AE
	20A320A		10AE
	20A460A		15AE
	35A170A	08AE-S	08AE
	35A320A	15AE-S	15AE
	35A460A		20AE
	40A400A		20AE
	40A600A		30AE
	80A400A		50AE
	80A600A		75AE

Note: The model combinations shown in this table are used when the maximum rated force of the applicable linear servomoter is required. To suppress rises in temperature, larger linear servomotors are used in some cases. If so, the SERVOPACK capacity can be lowered if using a motor at a lower force than the rated force. Calculate the required current and select a model with a margin of approximately 20%. An allowance can be made for up to 1/3 of the combined capacity of the linear servomotor and SERVOPACK in the table.

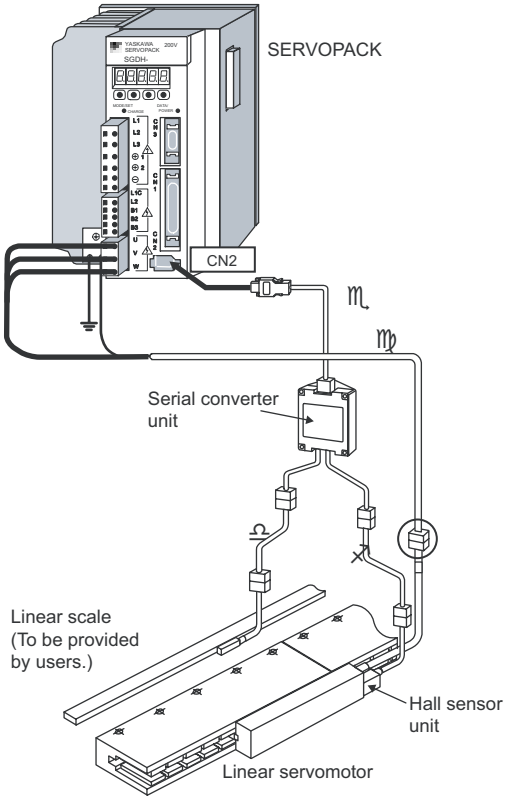
2.4 Serial Converter Units Models

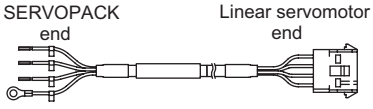
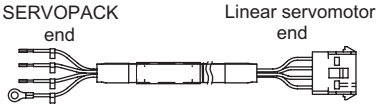
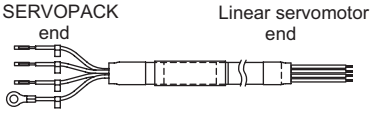
JZDP − A004 − 001

Serial Converter Unit Model			
Symbol	Appearance	Applicable Linear Scale	Hall Sensor
A004		Made by Renishaw	Yes

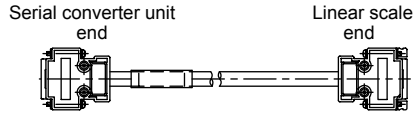
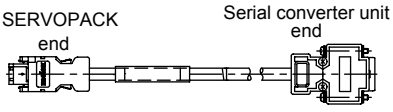
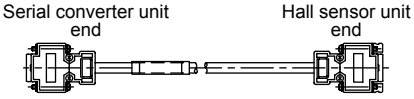
Applicable Linear Servomotor					
Servomotor Model		Symbol	Servomotor Model		Symbol
SGLGW (Coreless)	40A140B	001	SGLTW (Iron core, T-type)	20A170A	011
	40A253B	002		20A320A	012
	40A365B	003		20A460A	013
	60A140B	004		35A170A	014
	60A253B	005		35A320A	015
	60A365B	006		35A460A	016
SGLFW (Iron core, F-type)	20A090A	017		40A400A	007
	20A120A	018		40A600A	008
	35A120A	019		80A400A	009
	35A230A	020		80A600A	010
	50A200A	021			
	50A380A	022			
	1ZA200A	023			
	1ZA380A	024			

2.5 Selecting Cables



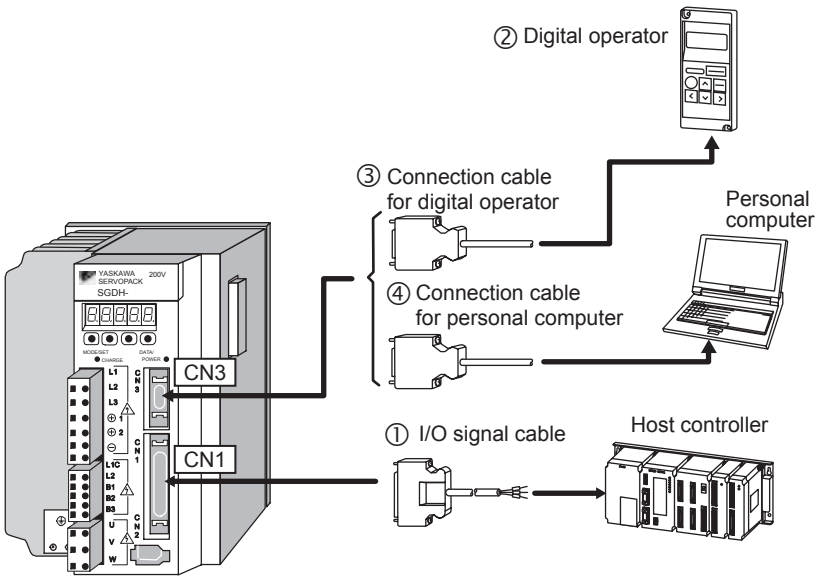
Name	Connection	Applicable Linear Servomotor Model	Cable Length	Cable Type	Specifications	
Linear Servomotor Main Circuit Cables	Between SERVOPACK and linear servomotor	SGLGW-40 and -60 SGLFW-20 SGLFW-35	1 m	JZSP-CLN11-01		
			3 m	JZSP-CLN11-03		
			5 m	JZSP-CLN11-05		
			10 m	JZSP-CLN11-10		
			15 m	JZSP-CLN11-15		
		SGLFW-50,-1Z SGLTW-20,-35	1 m	JZSP-CLN21-01		
			3 m	JZSP-CLN21-03		
			5 m	JZSP-CLN21-05		
			10 m	JZSP-CLN21-10		
			15 m	JZSP-CLN21-15		
		SGLTW-40,-80	1 m	JZSP-CLN39-01		
			3 m	JZSP-CLN39-03		
			5 m	JZSP-CLN39-05		
			10 m	JZSP-CLN39-10		
			15 m	JZSP-CLN39-15		

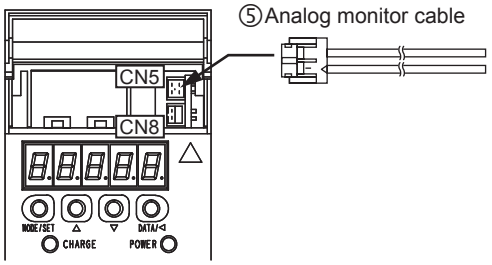
Note: A connector is not provided on the linear servomotor end of the main circuit cable, type JZSP-CLN39-_ _.
The user must provide the connector on the linear servomotor end.

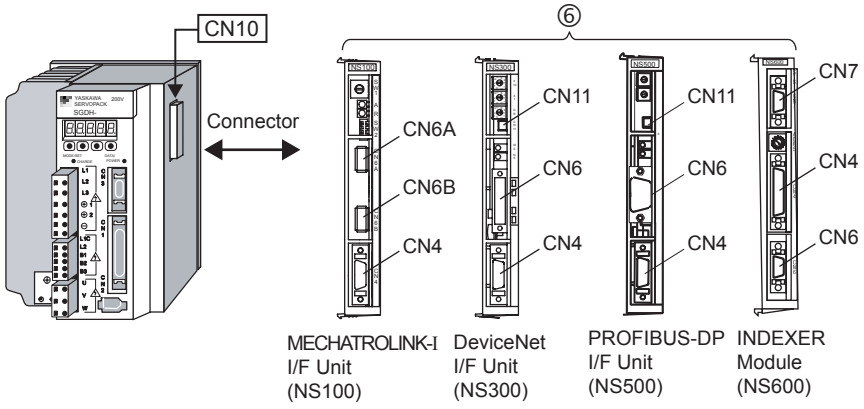
Name	Connection	Applicable Linear Servomotor Model	Cable Length	Cable Type	Specifications
Encoder Cables	Cable Extension Between serial converter unit and linear scale for Renishaw 15-pin connector	All models	1 m	JZSP-CLL00-01	
			3 m	JZSP-CLL00-03	
			5 m	JZSP-CLL00-05	
			10 m	JZSP-CLL00-10	
			15 m	JZSP-CLL00-15	
	Cable Extension Between serial converter unit and linear scale (Heidenhain). See Section 2.6.5	All models	1 m	JZSP-CLL20-01	
			3 m	JZSP-CLL20-03	
			5 m	JZSP-CLL20-05	
Connection cables for serial converter unit	Between SERVOPACK connector CN2 and serial converter unit	All models	3 m	JZSP-CLP20-03	
			5 m	JZSP-CLP20-05	
			10 m	JZSP-CLP20-10	
			15 m	JZSP-CLP20-15	
Connection cables for hall sensor	Between serial converter unit and hall sensor unit	All models	1 m	JZSP-CLL10-01	
			3 m	JZSP-CLL10-03	
			5 m	JZSP-CLL10-05	
			10 m	JZSP-CLL10-10	
			15 m	JZSP-CLL10-15	

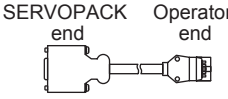
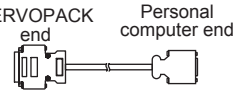
2.6 Selecting Peripheral Devices

2.6.1 Special Options







Name		Length	Type	Specifications	
CN1 I/O Signal Cables	Connector terminal block converter unit		JUSP-TA50P	Terminal block and 0.5 m connection cable	
	Cable with loose wires at one end	1 m	JZSP-CKI01-1	Loose wires at host controller end	
		2 m	JZSP-CKI01-2		
		3 m	JZSP-CKI01-3		
Digital Operator			JUSP-OP02A-2	With connection cable (1 m)	
CN3 Connection Cable for Digital Operator		1 m	JZSP-CMS00-1	Only required when using Σ-II series Digital Operator JUSP-OP02A-1. 	
CN3 Connection Cable for Personal Computer		2 m	YS-12	D-Sub 9-pin (For DOS/V) 	
CN5 Analog Monitor Cable		1 m	JZSP-CA01 or DE9404559		

Name		Type	
Application Module	MECHATROLINK-I I/F Unit (NS100)	JUSP-NS100	
	DeviceNet I/F Unit (NS300)	JUSP-NS300	
	PROFIBUS-DP I/F Unit (NS500)	JUSP-NS500	
	INDEXER Module (NS600)	JUSP-NS600	

* For details, refer to the manuals of each application module.

2.6.2 Molded-case Circuit Breaker and Fuse Capacity

Main Circuit Power Supply	SERVOPACK Model		Power Supply Capacity per SERVOPACK (kVA)	Current Capacity of the Molded-case Circuit Breaker and the Fuse (A_{rms}) *1 *2		Inrush Current	
	Capacity (kW)	SGDH-		Main Circuit Power Supply	Control Circuit Power Supply	Main Circuit Power Supply	Control Circuit Power Supply
Single-phase 200 V	0.05	A5AE	0.25	4	0.13	63A	60A
	0.10	01AE	0.40				
	0.20	02AE	0.75				
	0.40	04AE	1.2	8			
Three-phase 200 V	0.45	05AE	1.4	4	0.15 *3	118A	60A
	0.75	08AE	1.9	7			
	1.0	10AE	2.3				
	1.5	15AE	3.2	10			
	2.0	20AE	4.3	13		63A	
	3.0	30AE	5.9	17			
	5.0	50AE	7.5	28		67A	
	7.5	75AE	15.5	41	0.27 *3	40A	

*1. Nominal value at the rated load. The specified derating is required to select an appropriate fuse capacity.

* 2. Cutoff characteristics (25°C): 300% five seconds min. and inrush current of 20ms.

* 3. Make sure the current capacity is accurate. For the SERVOPACK with the cooling fan built-in, an inrush current flows; 200 % of the current capacity in the table above for two seconds, when turning ON the control circuit power supply to start the fan working.

Note: Do not use a fast-acting fuse. Because the SERVOPACK's power supply is a capacitor input type, a fast-acting fuse may blow when the power is turned ON.

IMPORTANT

The SGDH SERVOPACK does not include a protective grounding circuit. Install a ground-fault protector to protect the system against overload and short-circuit or protective grounding combined with the molded-case circuit breaker.

2.6.3 Noise Filters, Magnetic Contactors, Surge Suppressors and DC Reactors

Main Circuit Power Supply	SERVOPACK Model		Recommended Noise Filter		Magnetic Contactor	Surge Suppressor	DC Reactor
	Capacity (kW)	SGDH-	Type	Specifications			
Single-phase 200 V	0.05	A5AE	FN2070-6/07	Single-phase 250 VAC, 6 A	HI-11J (20 A)	TU-25C240	
	0.10	01AE					X5071
	0.20	02AE					X5070
	0.40	04AE	FN2070-10/07	Single-phase 250 VAC, 10 A			X5069
Three-phase 200 V	0.45	05AE	FN258L-7/07	Three-phase 480 VAC, 7 A	HI-11J (20 A)		X5061
	0.75	08AE	FN258L-16/07	Three-phase 480 VAC, 16 A	HI-15J (35 A)		
	1.0	10AE					
	1.5	15AE					X5060
	2.0	20AE			HI-20J (35 A)		
	3.0	30AE	FN258L-30/07	Three-phase 480 VAC, 30 A			X5059
	5.0	50AE	FMAC-0934-5010	Three-phase 440 VAC, 50 A	HI-25J (50 A)	TU-65C240	X5068
	7.5	75AE	FMAC-0953-6410	Three-phase 440 VAC, 64 A	HI-35J (65 A)		

Note: 1. If some SERVOPACKs are wired at the same time, select the proper magnetic contactors according to the total capacity.

2. The following table shows the manufacturers of each device.

Peripheral Device	Manufacturer
Noise Filter	FN, FS type: Schaffner Electronic FMAC type: Timonta AG
Magnetic Contactor	Yaskawa Controls Co., Ltd.
Surge Suppressor	Yaskawa Controls Co., Ltd.
DC Reactor	Yaskawa Controls Co., Ltd.

2.6.4 Regenerative Resistors

Main Circuit Power Supply	SERVOPACK Model		Regenerative Resistor		
	Capacity (kW)	SGDH-	Built-in		Externally connected
			Resistance (Ω)	Capacity (W)	
Single-phase 200 V	0.05	A5AE			
	0.10	01AE			
	0.20	02AE			
	0.40	04AE			
Three-phase 200 V	0.45	05AE	50	60	
	0.75	08AE			
	1.0	10AE			
	1.5	15AE	30	70	
	2.0	20AE	25	140	
	3.0	30AE	12.5	140	
	5.0	50AE	8	280	
	7.5	75AE	(3.13) *1	(1760) *1	JUSP-RA05

* 1. For the optional JUSP-RA05 Regenerative Resistor Unit.

Note: 1. If the SERVOPACK cannot process the regenerative power, an external regenerative resistor is required.

2. The following table shows the manufacturers of each device.

Peripheral Device	Manufacturer
External Regenerative Resistor	Iwaki Wireless Research Institute
External Regenerative Unit	Yaskawa Electric Corporation

2.6.5 Linear Scales

Manufacturer	Type	Output Signal	Resolution µm/pulse	Scale Pitch µm	Encoder Output Resolution Pn281	Max. Speed of Applicable Linear Servomotor m/s
Renishaw Inc.	RGH22B RGH24B RGH25B	1Vpp Analog voltage	0.078	20	1 to 31	5
					32 to 63	4
					64 to 127	2
					128 to 255	1
Heidenhain Corp.	LIDA187		0.156	40	1 to 63	5
					64 to 127	4
					128 to 255	2
	LIDA487 LIDA489		0.078	20	1 to 31	5
					32 to 63	4
					64 to 127	2
					128 to 255	1
	LIF181		0.016	4	1 to 31	1.0
					32 to 63	0.8
					64 to 127	0.4
					128 to 255	0.2

Note: 1. The linear scale signal is multiplied by eight bits (256 segmentation) inside the serial converter unit.

2. Using the zero-point signal with a linear scale made by Renishaw Inc. may cause a deviation in the home position. If so, adjust the setting so that the zero-point is output only in one direction by using BID/DIR signal.

3. This list does not cover all the applicable types of linear scales. And, the linear scales listed in the table may not be applicable or available if their specifications have been modified or their production has been stopped.
   Check the most recent catalog of the linear scale manufacturer to select a linear scale that meets the specifications.

4. Select a linear scale so that the total current consumption of the linear scale, serial converter unit, and hall sensor is 190 mA max.

5. At parameter (Pn280), set the scale pitch of the linear scale so that it satisfies the following condition. Otherwise, satisfactory control cannot be obtained.

$$\frac{64000}{\text{Pn280(Scale pitch (µm))}} \text{ must result in an integer number}$$

Examples
Correct: 1,2,4,8,10,16,20,40
Incorrect: 3,5,12,18

3

Digital Operator/Panel Operator

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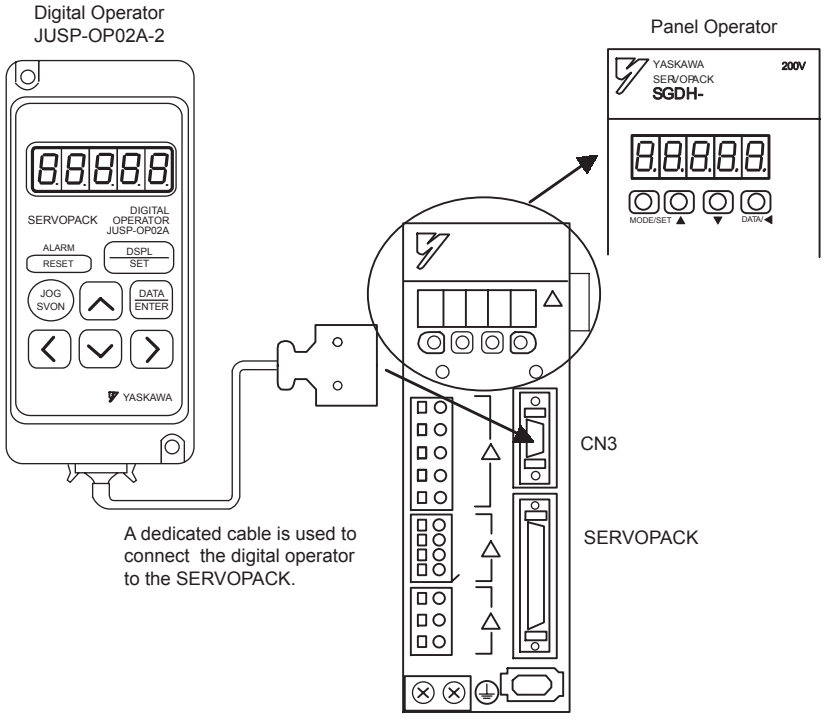
3.1 Functions on Digital Operator/Panel Operator

This section describes the basic operations of the digital operator (hereinafter called the digital operator) and the panel operator (hereinafter called the panel operator) for setting the operating conditions. Set parameters and JOG operation, and display status using these operators.

3.1.1 Connecting the Digital Operator

Two types of digital operators are available. One is a built-in operator that has a panel indicator and switches located on the front panel of the SERVOPACK. This type of digital operator is also called a panel operator. The other one is a hand-held operator (JUSP-OP02A-2 digital operator), which can be connected to the SERVOPACK with connector CN3 of the SERVOPACK.

There is no need to turn OFF the SERVOPACK to connect this hand-held operator to the SERVOPACK. Refer to the following illustrations to connect the digital operator to the SERVOPACK.



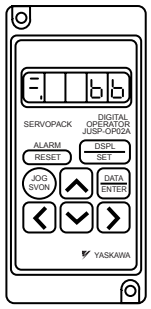
IMPORTANT	If the digital operator is connected to the SERVOPACK, the panel operator does not display anything.

3.1.2 Key Names and Functions

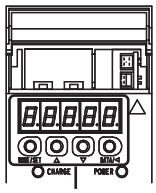
Key names and functions for the digital operator and the panel operator are explained below.

Set parameters and JOG operation, and display status using the panel operator.

Digital Operator



SERVOPACK



Panel Operator

Key		Function
Digital Operator	Panel Operator	
ALARM RESET (RESET Key)	+ Press simultaneously	To reset the servo alarm. Note 1. The servo alarm can be reset by /ALM-RST (CN1-44) input signal. 2. The servo alarm need not be reset if the control power supply is turned OFF.
DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	To select a basic mode, such as the status display mode, utility function mode, parameter setting mode, or monitor mode. Can be also used to set the data.
DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key)	To display parameter setting and set value.
(UP Key)	(UP Key)	Press the UP Key to increase the set value. For JOG operation, this key is used as Forward Run Start Key.
(DOWN Key)	(DOWN Key)	Press the DOWN Key to decrease the set value. For JOG operation, this key is used as Reserve Run Start Key.
(RIGHT Key)	–	Press the RIGHT Key to shift to the next digit on the right.
(LEFT Key)	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or DATA/SHIFT Key to shift to the next digit on the left.
JOG SVON (SVON Key)	MODE/SET (MODE/SET Key)	Press the SVON or MODE/SET Key to perform servo ON/OFF in the JOG operation with the operator.

IMPORTANT

When an alarm occurs, remove the cause, and then reset the alarm. Refer to *6.1 Troubleshooting*.

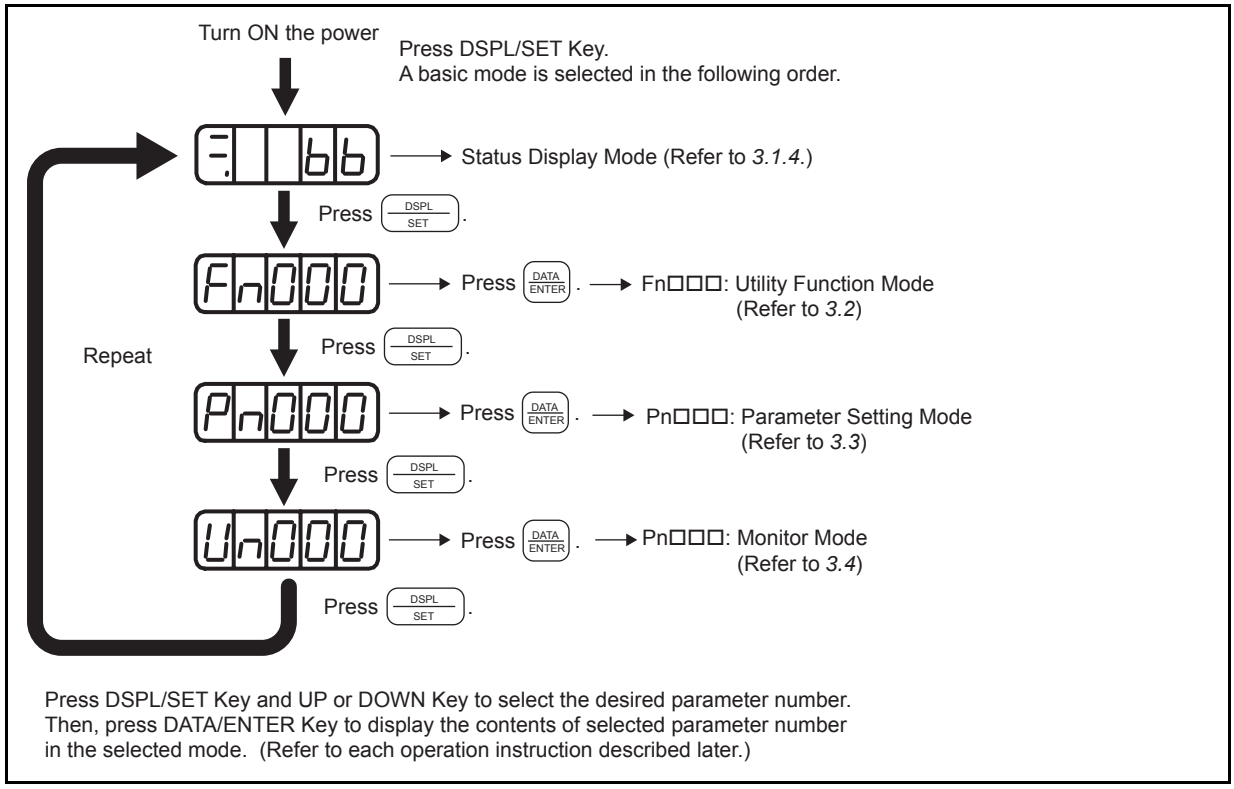
3.1.3 Basic Mode Selection and Operation

The basic modes include: Status display mode, Utility Function Mode, Parameter Setting Mode, and Monitor Mode.

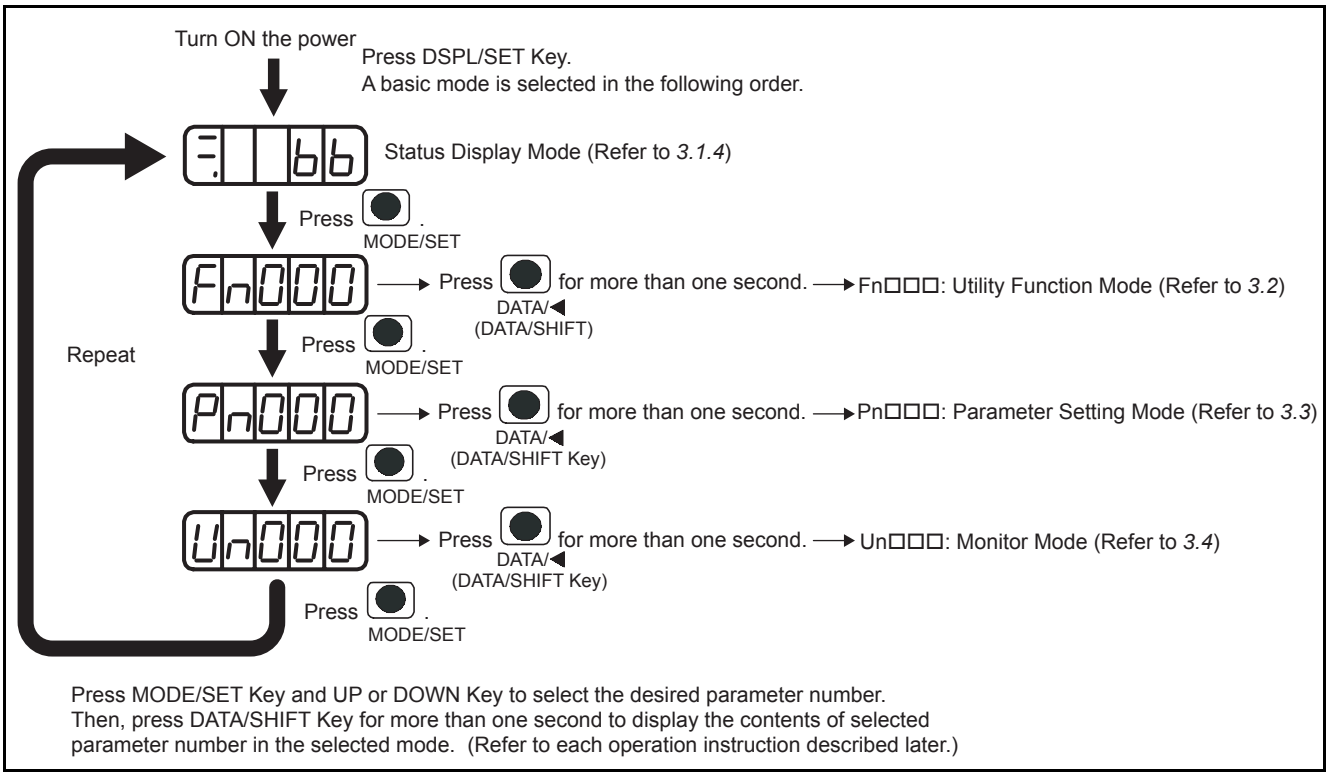
Select a basic mode to display the operation status, set parameters and operation references.

The basic mode is selected in the following order.

(1) Using the Digital Operator

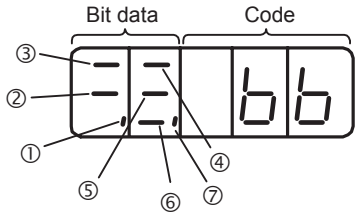

Turn ON the power
Press DSPL/SET Key.
A basic mode is selected in the following order.
Status Display Mode (Refer to 3.1.4.)
Press DSPL SET.
Press DATA ENTER. Fn□□□: Utility Function Mode (Refer to 3.2)
Repeat
Press DSPL SET.
Press DATA ENTER. Pn□□□: Parameter Setting Mode (Refer to 3.3)
Press DSPL SET.
Press DATA ENTER. Pn□□□: Monitor Mode (Refer to 3.4)
Press DSPL SET.
Press DSPL/SET Key and UP or DOWN Key to select the desired parameter number.
Then, press DATA/ENTER Key to display the contents of selected parameter number
in the selected mode. (Refer to each operation instruction described later.)

(2) Using the Panel Operator



Press MODE/SET Key and UP or DOWN Key to select the desired parameter number.
Then, press DATA/SHIFT Key for more than one second to display the contents of selected parameter number in the selected mode. (Refer to each operation instruction described later.)

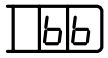
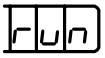
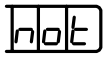
3.1.4 Status Display



(1) Bit Data and Meanings

Item	Speed or Force Control Mode		Position Control Mode	
	Bit Data	Meaning	Bit Data	Meaning
①	Control Power ON	Lit when SERVOPACK control power is ON.	Control Power ON	Lit when SERVOPACK control power supply is ON.
②	Baseblock	Lit for baseblock. Not lit when servo is ON.	Baseblock	Lit for baseblock. Not lit when servo is ON.
③	Speed Coincidence (/V-CMP)	Lit when the difference between the motor speed and reference speed is the same as or less than the value set in Pn582. (Factory setting is 10 mm/s.) ∗ Always lit in force control mode.	Positioning Completion (/COIN)	Lit if error between position reference and actual motor position is below preset value. Not lit if error between position reference and actual motor position exceeds preset value. Preset value: Set in Pn500 (Factory setting is 7 pulses.)
④	Movement Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn581 (Factory setting is 20 mm/s.)	Movement Detection (/TGON)	Lit if motor speed exceeds preset value. Not lit if motor speed is below preset value. Preset value: Set in Pn581 (Factory setting is 20 mm/s.)
⑤	Speed Reference Input	Lit if input speed reference exceeds preset value. Not lit if input speed reference is below preset value. Preset value: Set in Pn581 (Factory setting is 20 mm/s.)	Reference Pulse Input	Lit if reference pulse is input. Not lit if no reference pulse is input.
⑥	Force Reference Input	Lit if input force reference exceeds preset value. Not lit if input force reference is below preset value. Preset value: 10% of rated force	Error Counter Clear Signal Input	Lit when error counter clear signal is input. Not lit when error counter clear signal is not input.
⑦	Power Ready	Lit when main circuit power supply is ON and normal. Not lit when main circuit power supply power is OFF.	Power Ready	Lit when main circuit power supply is ON and normal. Not lit when main circuit power supply power is OFF.

(2) Codes and Meanings

Code	Meaning
	Baseblock Servo OFF (motor power OFF)
	Run Servo ON (motor power ON)
	Forward Run Prohibited CN1-42 (P-OT) is OFF.
	Reverse Run Prohibited CN1-43 (N-OT) is OFF.
	Alarm Status Displays the alarm number.
 :	

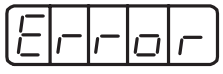
3.2 Operation in Utility Function Mode (Fn□□□)

3.2.1 List of Utility Function Modes

This section describes how to apply the basic operations using the panel operator to run and adjust the motor.
The following table shows the parameters in the utility function mode.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display	–	3.2.2
Fn001	Rigidity setting during online autotuning	○	5.2.5
Fn002	JOG mode operation	○	3.2.3
Fn003	Zero-point search mode	○	3.2.4
Fn005	Parameter setting initialization	○	3.2.5
Fn006	Alarm traceback data clear	○	3.2.6
Fn007	Writing to EEPROM mass ratio data obtained from online autotuning	○	5.2.7
Fn008	Fixed parameter	○	–
Fn009	Automatic tuning of analog (speed, force) reference offset	○	4.7.3 4.9.3
Fn00A	Manual adjustment of speed reference offset	○	4.7.3
Fn00B	Manual adjustment of force reference offset	○	4.9.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	3.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	3.2.8
Fn010	Password setting (protects parameters from being changed)	–	3.2.9
Fn011	Motor models display	–	3.2.10
Fn012	Software version display	–	3.2.11
Fn013	Fixed parameter	○	–
Fn014	Application module detection results clear	○	3.2.12

Note: When the parameters marked with "○" in remarks column or in Pn□□□ are set for Password Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



Blinks for one second

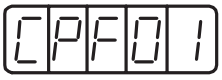
3.2.2 Alarm Traceback Data Display (Fn000)

The alarm traceback display can display up to 10 previously occurred alarms. The alarm data is displayed on Fn000, which is stocked in the alarm traceback data. The data can be cleared using an utility function mode "Alarm Traceback Data Clear." For details, refer to *3.2.6 Alarm Traceback Data Clear (Fn006)*.
The alarm traceback data is not cleared on alarm reset or when the SERVOPACK power is turned OFF. This does not adversely affect operation.

Alarm Sequence Number
The higher the number, the older the alarm data is.

Alarm Code
See the alarm table.

The following alarm are operator-related alarms which are not recorded in the traceback data.

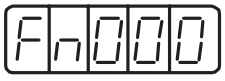
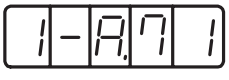
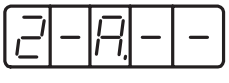
Display	Description
	Digital operator transmission error 1
	Digital operator transmission error 2

Refer to *6.1 Troubleshooting* for alarm number and contents.

INFO

1. Alarm traceback data will not be updated when the same alarm occurs repetitively.
2. The display "A.--" means no alarm occurs.

Follow the procedure below to confirm alarms which have been generated.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select "Alarm Traceback Data Display (Fn000)." If a number other than Fn000 is displayed, press UP Key or DOWN Key to set Fn000. Note: The enabled digit blinks.
2		DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The latest alarm data is displayed.
3		(UP Key)	(UP Key)	Press the UP Key to display the data for a previous alarm. (To display one newer alarm data, press DOWN Key.) Note: The higher the digit on the far left, the older the alarm data is.
4		(UP Key)	(UP Key)	Press the UP Key to display value in order. Note: "A.--" means no alarm occurs.
5		DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will return to Fn000.

3.2.3 JOG Mode Operation (Fn002)

⚠ CAUTION

- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are disabled during JOG mode operation.

The JOG mode operation is designed to move a linear servomotor without connecting to the host controller when performing the trial operation. The JOG mode operation is used to confirm the movement direction and motor speed setting.

(1) Precautions

Observe the following precautions when performing JOG mode operation.

- The SERVOPACK must be in servo ready state. The JOG mode operation cannot be performed while the SERVOPACK is in servo ON state.
- The servo ON (/S-ON) input signal must be OFF.
- If the parameter Pn50A.1 (/S-ON Signal Mapping) is set to "7 (Sets signal ON)," change the setting to "8 (Sets signal OFF)."

(2) Related Parameter

Pn383	JOG Speed		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000 mm/s	1 mm/s	50 mm/s	Immediately
Sets the motor speed reference value of the utility function Fn002 "JOG Mode Operation."				

(3) Operation Procedure

Use the following procedure to execute the JOG mode operation.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn002	∧ ∨		Press the UP or DOWN Key to select the Fn002. Note: The enabled digit binks.
3	-. .JOG	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key at least one second, and the display will be as shown on the left. The operator enters JOG operation mode.
4	. .JOG	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The servo turns ON.
5	Forward direction Reverse direction	∧ ∨		Press the UP Key for the forward direction or DOWN Key for the reverse direction. The linear servomotor moves as long as the key is pressed.
6	-. .JOG	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The servo turns OFF. Or, press the DATA/SHIFT Key at least one second to turn the servo OFF.
7	Fn002	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER once or DATA/SHIFT Key at least one second to return to the utility function mode display Fn002.

INFO The linear servomotor movement direction differs depending on the setting of parameter Pn000.0 “Direction Selection.” The above example shows the case of factory setting.

3.2.4 Zero-point Search Mode (Fn003)

⚠ CAUTION

- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are disabled during zero-point search mode operations using Fn003.

The zero-point search mode is designed to perform positioning to the zero-point pulse (phase-C) position of the linear scale that outputs the zero-point signal and to clamp at the position.

This mode is used to confirm that the linear scale outputs the zero-point signal correctly.

When the maximum speed is set to 5 m/s, the movement speed for executing the zero-point search is 60 mm/s.

The following conditions must be met to perform the zero-point search operation.

- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn 50A.1 is set to 7, and the servo has been set to always be ON.

Follow the procedure below to execute the zero-point search.

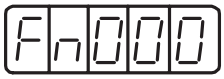
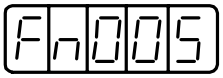
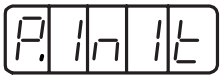
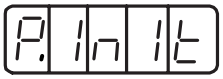
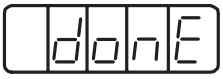
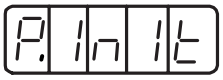
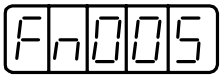
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn003	▲ ▼	▲ ▼	Press the UP or DOWN Key to select the Fn003. Note: The enabled digit blinks.
3	-.CSr	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4	.-.CSr	JOG SVON (SVON Key)	MODE/SET (MODE/SET Key)	Press the SVON or MODE/SET Key. The servo turns ON.
5	.-.CSr	▲ ▼	▲ ▼	When the parameter is set to Pn000.0 = 0 (default), pressing the UP Key will run the motor in the forward direction. Pressing the DOWN Key will run the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the movement direction of the motor is reversed.
6	.-.CSr	Display blinks.		When the motor zero-point search is completed, the display blinks. At this moment, the motor is servo-locked at the zero-point pulse position.
7	Fn003	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. Fn003 display appears again. The motor will be servo OFF status.

3.2.5 Parameter Settings Initialization (Fn005)

This function is used when returning to the factory settings after changing parameter settings.
Pressing the DSPL/SET or MODE/SET Key during servo ON does not initialize the parameter settings.
After initialization, turn OFF the power supply and then turn ON again.

IMPORTANT

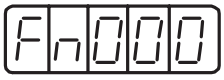
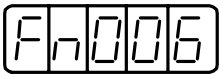
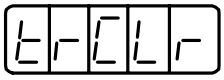
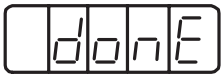
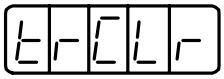
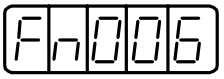
Initialize the parameter settings with the servo OFF.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn005. Note: The enabled digit blinks.
3		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. Then, the parameters will be initialized. During initialization, the display shown on the left blinks.
5		End of initialization		When the initialization of parameter setting completes, the display shown on the left blinks for about one second.
6		After about one second		The display changes from “donE” to the display shown on the left.
7		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn005.

3.2.6 Alarm Traceback Data Clear (Fn006)

This function clears the alarm traceback data, which stores the alarms generated in the SERVOPACK.

After having cleared data, "A.--" (No alarm) is set to all the alarm traceback data.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn006. Note: The enabled digit blinks.
3		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to clear the alarm traceback data. The display shown on the left blinks for about one second when the data is cleared.
5		After about one second		The display changes from "donE" to the display shown on the left.
6		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn006.

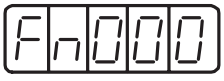
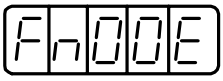
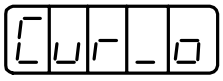
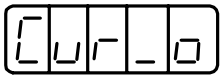
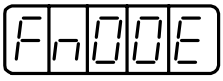
3.2.7 Automatic Offset-adjustment of Motor Current Detection Signal (Fn00E)

Automatic motor current detection offset adjustment has performed at Yaskawa before shipping. Basically, the user need not perform this adjustment.

Perform this adjustment only if highly accurate adjustment is required for reducing force ripple caused by current offset. Automatic adjustment is possible only with power supplied to the main circuit power supply and with the servo OFF.

IMPORTANT

Execute the automatic offset adjustment if the force ripple is too big when compared with that of other SERVOPACKs.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn00E. Note: The enabled digit blinks.
3		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The offset will be automatically adjusted. When the adjustment completes, the display shown on the left blinks for about one second.
5		After about one second		The display changes from "donE" to the display shown on the left.
6		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn00E.

3.2.8 Manual Offset-adjustment of Motor Current Detection Signal (Fn00F)

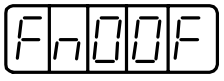
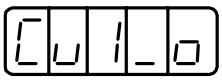
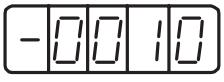
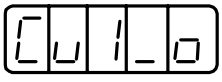
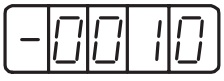
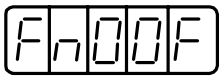
The adjusting range of the motor current detection offset is -512 to +511.

To adjust the offset, perform the automatic adjustment (Fn00E) first.

And if the force ripple is still big after the automatic adjustment, perform the manual adjustment.

IMPORTANT

If this function, particularly manual adjustment, is executed carelessly, it may worsen the characteristics. When performing manual adjustments, run the motor at a speed of approximately 100 mm/s, and adjust the operator until the force monitor ripple is minimized. (Refer to *5.5 Analog Monitor*.) Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.

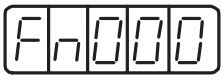
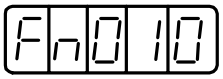
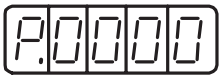
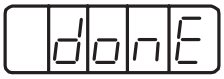
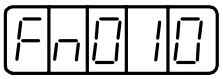
Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2		▲ ▼	▲ ▼	Press the UP or DOWN Key to select Fn00F. Note: The enabled digit blinks.
3		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left (phase U).
4		◀ ▶	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5		▲ ▼	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal.
6		◀ ▶	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second. The display shown on the left appears.
7		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The display shown on the left appears (phase V).
8		◀ ▶	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT or DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9		▲ ▼	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal.
10		◀ ▶	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second. The display shown on the left appears.
11		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	When the offset adjustment completes, press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display returns to the utility function mode display Fn00F.

3.2.9 Password Setting (Protects Parameters from Being Changed) (Fn010)

The write prohibited setting is used for preventing accidental changes of the parameter. All the parameters Pn□□□ and some of Fn□□□ become write prohibited by setting values. Refer to *3.2.1 List of Utility Function Modes* for details.

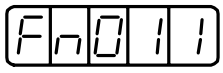
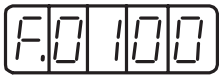
Setting values are as follows:

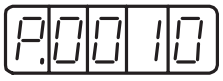
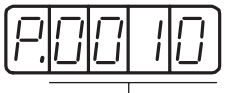
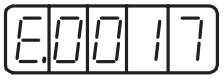
- "0000": Write permitted (Releases write prohibited mode.)
- "0001": Write prohibited (Parameters become write prohibited from the next power ON.)

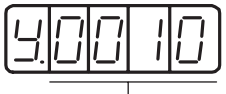
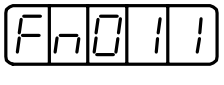
Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn010. Note: The enabled digit blinks.
3		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second, and the display will be as shown on the left.
4				Press the UP or DOWN Key to set a value: "0000": Write permitted, "0001": Write prohibited
5		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to register the value. When the value is registered, the display shown on the left blinks for about one second. Note: If a value other than "0000" and "0001" is set, "Error" blinks for about one second, and the previous setting is displayed.
6		After about one second		The display changes from "donE" to "P.000□."
7		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn010.

3.2.10 Motor Models Display (Fn011)

This mode is used for motor maintenance, set the parameter Fn011 to select the motor model check mode. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

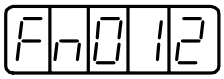
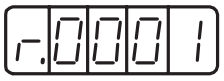
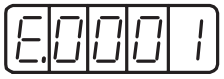
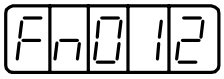
<table>
<tr><th>Step</th><th>Display after Operation</th><th>Digital Operator</th><th>Panel Operator</th><th>Description</th></tr>
<tr><td>1</td><td> </td><td>
(DSPL/SET Key)</td><td>
MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to select the utility function mode.</td></tr>
<tr><td>2</td><td>  </td><td> </td><td> </td><td>Press the UP or DOWN Key to select Fn011.
Note: The enabled digit blinks.</td></tr>
<tr><td>3</td><td>  </td><td>
(DATA/ENTER Key)</td><td>
DATA◀
(DATA/SHIFT Key)
(Press at least 1 s.)</td><td>Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the linear servomotor model and voltage code.

<table><tr><th colspan="2">Linear Servomotor Voltage</th></tr><tr><th>Data</th><th>Model</th></tr><tr><td>01</td><td>200 VAC or 280 VDC</td></tr><tr><td>02</td><td>400 VAC or 560 VDC</td></tr></table><table><tr><th colspan="2">Linear Servomotor Type</th></tr><tr><th>Data</th><th>Type</th></tr><tr><td>40</td><td>Linear servomotor</td></tr></table></td></tr>
<tr><td>4</td><td>  </td><td>
(DSPL/SET Key)</td><td>
MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to display the servomotor capacity.
 
Motor capacity in units of 10 W
The above example indicates 100 W.</td></tr>
<tr><td>5</td><td>  </td><td>
(DSPL/SET Key)</td><td>
MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key, and the linear scale type and resolution code will be displayed.

<table><tr><th colspan="2">Linear Scale Type</th></tr><tr><th>Data</th><th>Type</th></tr><tr><td>00</td><td>Incremental</td></tr></table><table><tr><th colspan="2">Scale Pitch Multiplication</th></tr><tr><th>Data</th><th>Resolution</th></tr><tr><td>8</td><td>8-bit</td></tr></table></td></tr>
<tr><td>6</td><td> </td><td>
(DSPL/SET Key)</td><td>
MODE/SET
(MODE/SET Key)</td><td>Press the DSPL/SET or MODE/SET Key to display the SERVOPACK's code for custom orders.
Note: The display "y.0000" means standard model.
 
Code for custom orders</td></tr>
<tr><td>7</td><td>  </td><td>
(DATA/ENTER Key)</td><td>
DATA◀
(DATA/SHIFT Key)
(Press at least 1 s.)</td><td>Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode display Fn011.</td></tr>
</table>

3.2.11 Software Version Display (Fn012)

Set the Fn012 to select the software-version check mode to check the SERVOPACK and encoder software version numbers.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select Fn012. Note: The enabled digit blinks.
3		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the SERVOPACK software version number.
4		DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to display the encoder software version number.
5		DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the utility function mode Fn012.

3.2.12 Application Module Detection Results Clear (Fn014)

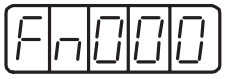
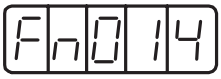
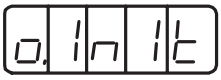
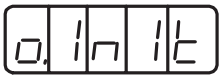
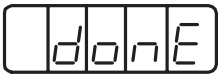
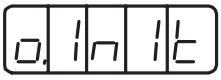
The alarm A.E7 (application module detection error) occurs when turning ON the power for the first time when the SERVOPACK is used without application module after the SERVOPACK has been used with application module.

Clearing application module detection results is performed as using the SERVOPACK individually without operating the application module detection.

Restarting again after performing the following operation will clear and reset the alarm A.E7. Then, the operation of SERVOPACK without application module is enabled.

IMPORTANT

Because the parameter is set for the SERVOPACK with an application module, change the setting or initialize the parameter value (Fn005 of utility function mode) as required.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the UP or DOWN Key to select the Fn014. Note: The enabled digit blinks.
3		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/ SHIFT Key for more than one second, and the display will be as shown on the left.
4	 Blinks ↓ 	(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key, and the display will be as shown on the left to clear the application module detection.
5		After about one second		The display changes from “donE” to the display shown on the left.
6		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/ SHIFT Key for more than one second to return to the utility function mode.

3.3 Operation in Parameter Setting Mode (Pn□□□)

Functions can be selected or adjusted by setting parameters. There are two types of parameters. One type requires value setting and the other requires function selection. These two types use different setting methods.

With value setting, a parameter is set to a value within the specified range of the parameter. With function selection, the functions allocated to each digit of the seven-segment LED panel indicator (five digits) can be selected.

3.3.1 Setting Parameters

(1) Value Setting Parameters

(a) Types of Value Setting Parameters

Refer to *7.4.2 List of Parameters.*

(b) Example of Changing Value Setting Parameter

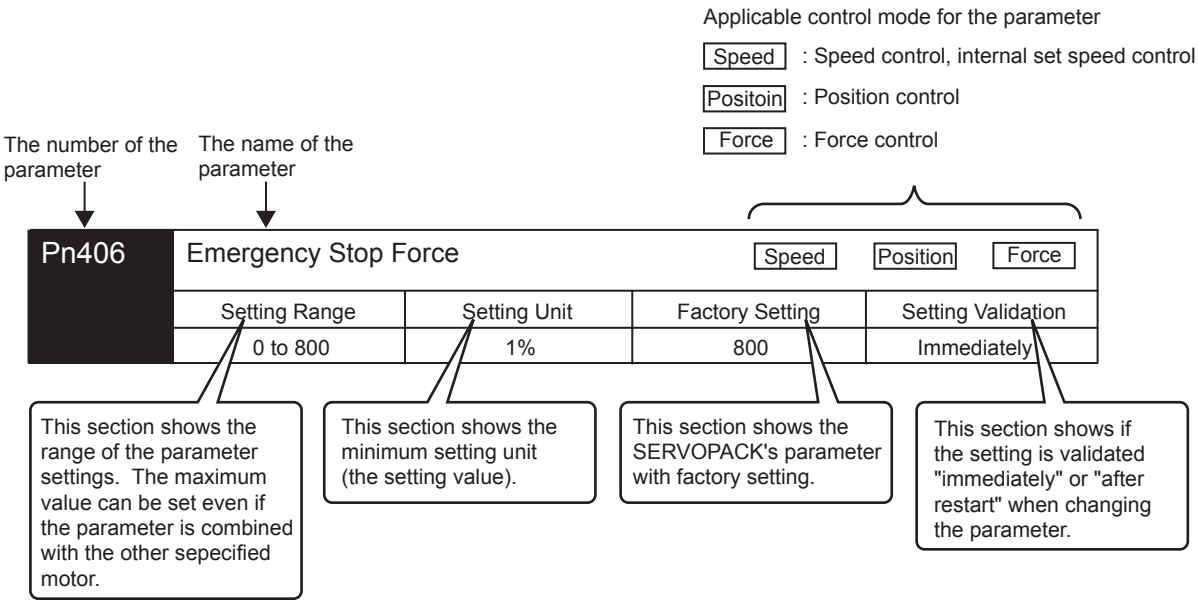
The parameter settings can be used for changing parameter data. Before changing the data, check the permitted range of the parameter.

◀ EXAMPLE ▶ The example below shows how to change parameter Pn100 (speed loop gain) from "40" to "100."

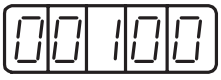
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn100	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the parameter setting mode. If a parameter other than Pn100 is displayed, press the UP or DOWN Key to select Pn100. Note: The enabled digit blinks.
2	00040	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The current data of Pn100 is displayed.
3	00040	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the digit to be set.
4	00100	▲ ▼	▲ ▼	Press the UP or DOWN Key to change the data. Keep pressing UP or DOWN Key until "00100" is displayed.
5	00100	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn100	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display of Pn100. The data for the speed loop gain (Pn100) is changed from "40" to "100."

(c) Parameter Indications

In this manual, the parameter is explained with using the following format.


Applicable control mode for the parameter
Speed : Speed control, internal set speed control
Positoin : Position control
Force : Force control
The number of the parameter
The name of the parameter
Pn406
Emergency Stop Force
Speed
Position
Force
Setting Range
Setting Unit
Factory Setting
Setting Validation
0 to 800
1%
800
Immediately
This section shows the range of the parameter settings. The maximum value can be set even if the parameter is combined with the other sepecified motor.
This section shows the minimum setting unit (the setting value).
This section shows the SERVOPACK's parameter with factory setting.
This section shows if the setting is validated "immediately" or "after restart" when changing the parameter.

The following alarm shows the setting value of the parameter.



Decimal display in five digits

(2) Function Selection Parameters

(a) Types of Function Selection Parameters

IMPORTANT

If the parameters with "After restart" in "Setting Validation" column in the table are changed, turn OFF the main circuit and control power supply and ON again to validate new setting.

- Pn10B.1 and Pn110.0 require the power to be reset as mentioned above.
- Pn10B.0, Pn110.1, and Pn110.2 are enabled with the off-line, so the power does not have to be reset.

Category	Parameter No.	Name	Factory Setting	Setting Validation
Function Selection Parameter	Pn000	Function Selection Basic Switch	0000	After restart
	Pn001	Function Selection Application Switch 1	0000	After restart
	Pn002	Function Selection Application Switch 2	0000	After restart
	Pn003	Function Selection Application Switch 3	0002	Immediately
	Pn080	Function Selection Application Switch 80	0000	After restart
Servo Gain Related Parameter	Pn10B	Gain Application Switches	0000	After restart/ Immediately
	Pn110	Online Autotuning Switches	0010	After restart/ Immediately
Position Control Related Parameter	Pn200	Position Control References Selection Switches	0000	After restart
	Pn207	Position Control Function Switches	0000	After restart
	Pn218	Reference Pulse Multiplication Function Selection (For the software version 32 or later)	0000	After restart
Force Control Related Parameter	Pn408	Force Function Switches	0000	Immediately
Sequence Related Parameter (Input Signal Selection)	Pn50A	Input Signal Selection 1	2100	After restart
	Pn50B	Input Signal Selection 2	6543	After restart
	Pn50C	Input Signal Selection 3	8888	After restart
	Pn50D	Input Signal Selection 4	8888	After restart
	Pn513	Input Signal Selection 5 (For the software version 32 or later)	0088	After restart
Sequence Related Parameter (Output Signal Selection)	Pn50E	Output Signal Selection 1	3211	After restart
	Pn50F	Output Signal Selection 2	0000	After restart
	Pn510	Output Signal Selection 3	0000	After restart
	Pn512	Output Signal Reversal Setting	0000	After restart

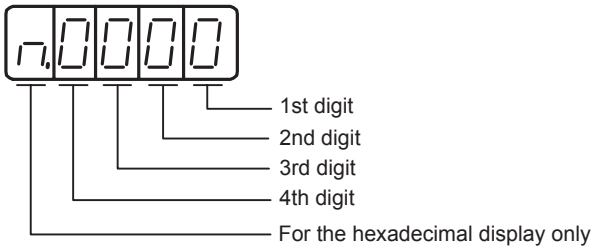
(b) Example of Changing Function Selection

The procedure to change the setting of control method selection (Pn000.1) of the function selection basic switches (Pn000) from speed control to position control is shown below.

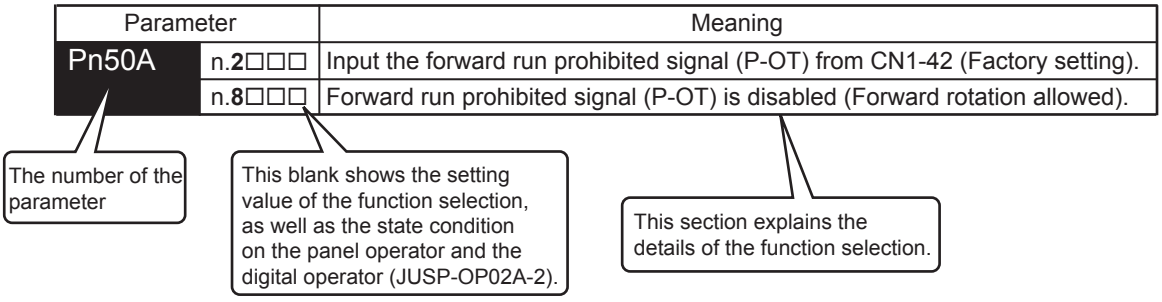
Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the parameter setting mode. If a parameter other than Pn000 is displayed, press the UP or DOWN Key to select the Pn100. Note: The enable digit blinks.
2	n.0000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The current data of Pn000 is displayed.
3	n.0000	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT or DATA/SHIFT Key to select the first digit of current data.
4	n.0010	▲ (UP Key)		Press the UP Key once to change to "n.0010." (Set the control method to position control.)
5	n.0010	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
6	Pn000	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn000. The control method is changed to position control.
7	To enable the change in the setting of function selection basic switches (Pn000), turn OFF the power and ON again.			

(c) Parameter Indications

Each digit of the function selection parameters is defined as the hexadecimal display. The parameter display example shows how parameters are displayed in digits for set values.



- Pn000.0 or n.xxx□: Indicates the value for the 1st digit of parameter Pn000.
- Pn000.1 or n.xx□x: Indicates the value for the 2nd digit of parameter Pn000.
- Pn000.2 or n.x□xx: Indicates the value for the 3rd digit of parameter Pn000.
- Pn000.3 or n.□xxx: Indicates the value for the 4th digit of parameter Pn000.


Parameter
Meaning
Pn50A
n.2□□□
Input the forward run prohibited signal (P-OT) from CN1-42 (Factory setting).
n.8□□□
Forward run prohibited signal (P-OT) is disabled (Forward rotation allowed).
The number of the parameter
This blank shows the setting value of the function selection, as well as the state condition on the panel operator and the digital operator (JUSP-OP02A-2).
This section explains the details of the function selection.

3.3.2 Input Circuit Signal Allocation

Each input signal is allocated to a pin of the input connector CN1 by setting the parameter.

The following table shows detailed allocation.

(1) Factory Setting (Pn50A.0 = 0)

The factory setting for the input signal allocation is as follows.

▭ means factory setting.

Pn50A: n.2100

Pn50B: n.6543

(2) Changing the Allocation (Pn50A.0 = 1)

Set the parameter in accordance with the relation between the signal to be used and the input connector pin. After having changed the parameter, turn OFF the power and ON again to enable the parameters.

□ means factory setting.

Signal Name	Validity Level	Input Signal	CN1 Input Pin Allocation							Connection Not Required (SERVOPACK judges the connection)	
Parameter Setting Allocation			40	41	42	43	44	45	46	Always ON	Always OFF
Servo ON Pn50A.1 = n.xx□x	L	/S-ON	0	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference Pn50A.2 = n.x□xx	L	/P-CON	0	1	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forward Run Prohibited Pn50A.3 = n.□xxx	H	P-OT	0	1	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Reverse Run Prohibited Pn50B.0 = n.xxx□	H	N-OT	0	1	2	3	4	5	6	7	8
	L	/N-OT	9	A	B	C	D	E	F		
Alarm Reset Pn50B.1 = n.xx□x	L	/ARM-RST	0	1	2	3	4	5	6	–	8
	H	ARM-RST	9	A	B	C	D	E	F		
Forward External Force Limit Pn50B.2 = n.x□xx	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
Reserve External Force Limit Pn50B.3 = n.□xxx	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.0 = n.xxx□	L	/SPD-D	0	1	2	3	4	5	6	7	8
	H	SPD-D	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.1 = n.xx□x	L	/SPD-A	0	1	2	3	4	5	6	7	8
	H	SPD-A	9	A	B	C	D	E	F		
Internal Set Speed Selection Pn50C.2 = n.x□xx	L	/SPD-B	0	1	2	3	4	5	6	7	8
	H	SPD-B	9	A	B	C	D	E	F		
Control Method Selection Pn50C.3 = n.□xxx	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp Pn50D.0 = n.xxx□	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit Pn50D.1 = n.xx□x	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover Pn50D.2 = n.x□xx	L	/G-SEL	0	1	2	3	4	5	6	7	8
	H	G-SEL	9	A	B	C	D	E	F		
Polarity Detection Pn50D.3 = n.□xxx	L	/P-DET	0	1	2	3	4	5	6	7	8
	H	P-DET	9	A	B	C	D	E	F		
Reference Pulse Input Multiplication* Pn513.0 = n.xxx□	L	/P-SEL	0	1	2	3	4	5	6	7	8
	H	P-SEL	9	A	B	C	D	E	F		

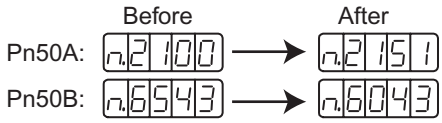
* This function is valid for the software version 32 or later.

IMPORTANT

1. When using Servo ON, Forward Run Prohibited, and Reverse Run Prohibited signals with the setting "Polarity Reversal," the machine may not move to the specified safe direction at occurrence of failure such as signal line disconnection. If such setting is absolutely necessary, confirm the operation and observe safety precautions.
2. When two or more signals are allocated to the same input circuit, the input signal level will be applied to all the allocated signal.

(3) Allocating Input Signals

◀ EXAMPLE ▶ The procedure to replace Servo ON (/S-ON) signal allocated to CN1-40 and Forward External Force Limit (/P-CL) allocated to CN1-45 is shown below.



Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn50A	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the "value setting parameter" mode. If a parameter other than Pn50A is displayed, press the UP or DOWN Key to set Pn50A. Note: The enabled digit blinks.
2	n.2100	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50A. (/S-ON is allocated to CN1-40.)
3	n.2101	(UP Key)	DATA/◀ (DATA/SHIFT Key)	Press the UP Key to set to "1." (Sequence input signals can be freely set.)
4	n.2151	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the second digit from the right. Press the UP key to set to "5." (Changes the allocation of /S-ON from CN1-40 to CN1-45.)
5	n.2151	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved. At the moment, the CN1-45 operates with OR logic for /S-ON and /P-CL.
6	Pn50A	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50A.
7	Pn50b	(UP Key)	(UP Key)	Press the UP Key to set Pn50B. Note: The enabled digit blinks.
8	n.6543	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50B. (/P-CL is allocated to CN1-45.)
9	n.6043	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set to "0." (Changes the allocation of /P-CL from CN1-45 to CN1-40.)
10	n.6043	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
11	Pn50b	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50B. /S-ON is allocation to CN1-45, and /P-CL is allocated to CN1-40.
12	Turn the power OFF and ON again to enable the change of input signal selections (Pn50A and Pn50B).			

3.3.3 Output Circuit Signal Allocation

Functions can be allocated to the following sequence output signals. After having changed the parameter, turn OFF the power and ON again to enable the parameters.

□ means factory setting.

CN1 Pin No.		25/(26)		27/(28)		29/(30)		Remark
Parameter Setting Allocation		Pn512=n.xxx□		Pn512=n.xx□x		Pn512=n.x□xx		
		0	1	0	1	0	1	
Positioning Completion (/COIN) Pn50E.0 = n.xxx□	0	Invalid						L: Valid output signal: Low level H: Valid output signal: High level Invalid: Do not use the output signal. ■ Factory Setting Pn50E: n.3211 Pn50F: n.0000 Pn510: n.0000 Pn512: n.0000 Note: The output signals for Positioning Completion Signal and Speed Coincidence Detection Signal differ depending on the control method.
	1	L	H					
	2			L	H			
	3					L	H	
Speed Coincidence Detection (/V-CMP) Pn50E.1 = n.xx□x	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Movement Detection (/TGON) Pn50E.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Servo Ready (/S-RDY) Pn50E.3 = n.□xxx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Force Limit Detection (/CLT) Pn50F.0 = n.xxx□	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Speed Limit Detection (/VLT) Pn50F.1 = n.xx□x	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Brake (/BK) Pn50F.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Warning (/WARN) Pn50F.3 = n.□xxx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Near (/NEAR) Pn510.0 = n.xxx□	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Reference Pulse Input Multiplication (/PSELA)* Pn510.2 = n.x□xx	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	

* This function is valid for the software version 32 or later.

IMPORTANT

1. When two or more signals are allocated to the same output circuit, a signal is output with OR logic.
2. The signals not detected are considered as "Invalid." For example, Positioning Completion (/COIN) Signal in speed control mode is "Invalid."

- Allocating Output Signals

◀ EXAMPLE ▶ The procedure to replace Movement Detection (/TGON) signal allocated to CN1-27 (28) with factory setting to "Invalid" and allocate Brake Interlock (/BK) signal to CN1-27 (28) is shown below.

Before → After

Pn50E: n.3211 → n.3011

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Pn50E	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the "value setting parameter" mode. If a parameter other than Pn50E is displayed, press the UP or DOWN Key to select Pn50E. Note: The enabled digit blinks.
2	n.3211	DATA/ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50E. (/TGON is allocated to CN1-27 (28).)
3	n.3011	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT Key or RIGHT or DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Sets /TGON "Invalid.")
4	n.3011	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
5	Pn50E	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50E.
6	Pn50F	∧ (UP Key)	▲ (UP Key)	Press the UP Key to set Pn50F. Note: The enabled digit blinks.
7	n.0000	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the current data of Pn50F. (/BK is set to "Invalid.")
8	n.0200	◀ ▶	DATA/◀ (DATA/SHIFT Key)	Press the LEFT or RIGHT Key or DATA/SHIFT Key to select the third digit from the right. Press the UP Key to set "2." (Allocates /BK to CN1-27 (28).)
9	n.0200	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The value blinks and is saved.
10	Pn50F	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is allocated to CN1-27 (28).
11	Turn OFF the power and ON again to enable the changes of output signal selection (Pn50E and Pn50F).			

3.4 Operation in Monitor Mode (Un□□□)

The monitor mode can be used for monitoring the reference values, I/O signal status, and SERVOPACK internal status.
The monitor mode can be selected during motor operation.

3.4.1 List of Monitor Modes

Parameter No.	Content of Display	Unit
Un000	Actual motor speed	mm/s
Un001	Input speed reference (Valid only in speed control mode)	mm/s
Un002	Internal force reference (in percentage to the rated force)	%
Un003 *1	Electrical angle 1 (32-bit decimal code)	Number of pulses from the phase-C (zero-point)
Un004	Electrical angle 2 (Angle from 0 (zero) degree of phase-U))	deg
Un005 *2	Input signal monitor	–
Un006 *2	Output signal monitor	–
Un007	Input reference pulse speed (valid only in position control mode)	mm/s
Un008	Error counter value (amount of position error) (valid only in position control mode)	reference unit
Un009	Accumulated load rate (value for the rated force as 100 %. Displays effective force in 10-s cycle.)	%
Un00A	Regenerative load rate (value for the processable regenerative power as 100 %. Displays regenerative power consumption in 10-s cycle.)	%
Un00B	Power consumed by DB resistance (Value for the processable power when dynamic brake is applied as 100 %. Displays power consumed by DB resistance in 10-s cycle.)	%
Un00C *3	Input reference pulse counter (32-bit hexadecimal code) (valid only in position control mode)	–
Un00D *3	Feedback pulse counter (32-bit hexadecimal code)	–
Un010	Allowable maximum motor speed and dividing ratio monitor (For the software version 32 or later)	100 mm/s or pulse/ scale pitch (Pn280)
Un011	Hall sensor signal monitor (For the software version 32 or later)	–

* 1. This parameter can not be used when the linear scale does not have zero point.
* 2. Refer to *3.4.2 Sequence I/O Signal Monitor Display*.
* 3. Refer to *3.4.4 Monitor Display of Reference Pulse Counter and Feedback Pulse Counter*.

3.4.2 Sequence I/O Signal Monitor Display

The following section describes the monitor display for sequence I/O signals.

(1) Input Signal Monitor Display

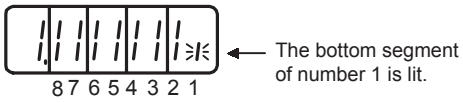
The status of input signal allocated to each input terminal is displayed:
When the input is in OFF (open) status, the top segment (LED) is lit.
when the input is in ON (short-circuited) status, the bottom segment (LED) is lit.

Refer to *3.3.2 Input Circuit Signal Allocation* for the relation between input terminals and signals.

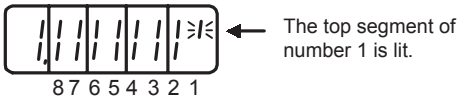
Display LED Number	Input Terminal Name	Factory Setting
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL

◀ EXAMPLE ▶

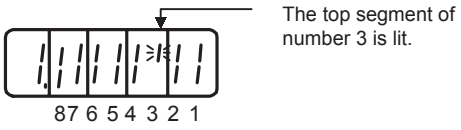
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at H level)



(2) Output Signal Monitor Display

The status of output signal allocated to each output terminal is displayed:
When the output is in OFF (open) status, the top segment (LED) is lit.
When the output is in ON (short-circuited) status, the bottom segment is lit.

Refer to *3.3.3 Output Circuit Signal Allocation* for the relation between output terminals and signals.

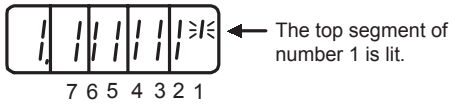
Display LED Number	Output Terminal Name	Factory Setting
1	CN1-31, -32	ALM
2	CN1-25, -26	/COIN or /V-CMP
3	CN1-27, -28	/TGON
4	CN1-29, -30	/S-RDY
5	CN1-37	AL01
6	CN1-38	AL02
7	CN1-39	AL03

Seven segments in the top and bottom rows of an LED turn ON and OFF in different combinations to indicate various output signals.

These segments ON for L level and OFF for H level.

◀ EXAMPLE ▶

- When ALM signal operates (alarm at H level.)



3.4.3 Operation in Monitor Mode

The example below shows how to display the contents of monitor number Un000 when the linear servomotor runs at 1500 mm/s.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2				Press the UP or DOWN Key to select the monitor number to be displayed. The display shows the example of the data of Un000.
3		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to display the data of Un000.
4		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the display of monitor number.

3.4.4 Monitor Display of Reference Pulse Counter and Feedback Pulse Counter

The monitor display of reference pulse counter and feedback pulse counter is expressed in 32-bit hexadecimal.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2				Press the UP or DOWN Key to select “Un00C” or “Un00D.”
3	The upper 16-bit data	(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/ SHIFT Key for more than one second to display the data of the selected monitor number.
4	The lower 16-bit data			Press the UP or DOWN Key to display the lower 16-bit data.
5		(Press simultaneouly)	Press simultaneously	Press both UP and DOWN Keys simultaneously while the display on the left appears to clear the 32-bit counter data. (The display shown on the left is of the lower 16-bit data.)
6		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/ SHIFT Key for more than one second to return to the display of monitor number.

When the control power supply is turned ON, reference pulse and feedback pulse will be “0.” The counter value increases by forward references, and decreases by reverse references.

Displays the pulse number from 0 to FFFFFFFF (4294967295) in sequence. If one pulse is decreased from 0, the digital operator and the panel operator display FFFFFFFF (4294967295) and then decrease from this pulse number. Also, if one pulse in increased from FFFFFFFF (4294967295), the digital operator and the panel operator display 0 and increase from this pulse number.

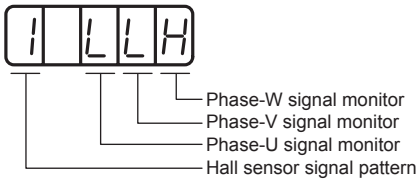
When using the 8-bit serial converter unit, the feedback pulse will be 256 pulses/scale pitch.

3.4.5 Allowable Maximum Motor Speed for Dividing Ratio Monitor (For the software version 32 or later)

Encoder resolution defines another speed limit (input sinusoidal frequency).

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Un000	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2	Un010	∧ ∨	▲ ▼	Press the UP or DOWN Key to select "Un010."
3	5,0050	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once or DATA/SHIFT Key for more than one second to display the motor maximum speed that can be set.
4	P.0020	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to display the maximum dividing ratio that can be set.
5	Un010	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once or DATA/SHIFT Key for more than one second to return to the display of monitor number.

3.4.6 Hall Sensor Signal Monitor (For the software version 32 or later)

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Un000	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the monitor mode.
2	Un011	∧ ∨	▲ ▼	Press the UP or DOWN Key to select "Un011."
3	1 LLH	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Prss the DATA/ENTER Key once or DATA/SHIFT Key for more than one second to display the hall sensor signal pattern. 
4	Un011	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once or DATA/SHIFT Key for more than one second to return to the display of monitor number.

Hall Sensor Signal Pattern	Signal Monitor		
	Phase-U	Phase-V	Phase-W
1	L	L	H
2	L	H	L
3	L	H	H
4	H	L	L
5	H	L	H
6	H	H	L

4

Operation

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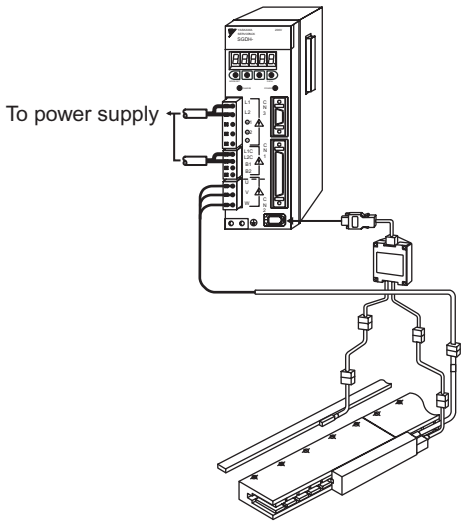
4.1 Trial Operation

Perform a trial operation after wiring is completed.

Use the following procedure to perform a trial operation. The procedures for Speed Control Mode (standard setting) and Position Control Mode are described in this chapter. When a specific explanation is not provided, use the default parameters.

(1) Trial Operation Using SERVOPACK Internal References
(Refer to *4.2 Trial Operation Using SERVOPACK Internal References*.)

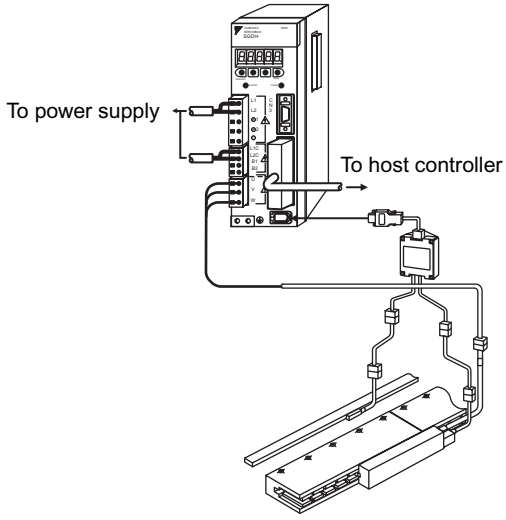


■ Purpose

Run the linear servomotor without host reference input.
Check that the following wiring and settings are correct.

- Power supply circuit wiring
- Linear servomotor wiring
- Serial converter unit wiring
- Linear scale wiring
- Hall sensor wiring
- Scale pitch setting
- Scale signal count direction and count quantity
- Motor movement direction and movement speed
- Force limit parameter setting
- Polarity detection operation (only if polarity detection is used.)

(2) Trial Operation Using Host References
(Refer to *4.3 Trial Operation for Linear Servomotor without Load from Host Reference*.)



■ Purpose

Run the linear servomotor with host reference input.
Check that the following wiring and settings are correct.

- I/O signal wiring with the host controller
- Linear servomotor movement direction, movement speed, and movement distance
- Operation of brake, overtravel, and other protective functions
- Required parameter settings

Step	Item	Description	Reference
1	Installation and mounting	Install the linear servomotor and SERVOPACK according to the installation conditions.	–
↓			
2	Wiring and connections	Wire and connect the power supply circuit (L1, L2, or L1, L2, L3), linear servomotor (U, V, W), input signal (CN1), and serial converter unit (CN2). Disconnect the CN1 connector during trial operation using SERVOPACK internal references (Refer to *4.2 Trial Operation Using SERVOPACK Internal References*).	–
↓			
3	Turn ON the power.	Turn ON the power. Check the panel operator to make sure that the SERVOPACK is running normally. The alarm A.08 does not indicate an error.	–
↓			
4	Linear scale check	Set the linear scale pitch (Pn280). After setting validation, check the linear scale status using the panel operator.	–
↓			
5	Polarity detection operation check (only for detection)	Check whether the polarity is being correctly detected.	–
↓			
6	Jog operation	After setting the mass ratio (Pn103), perform jog operation.	Jog operation
↓			
7	Connect input signals.	Connect I/O signals (CN1) necessary for the trial operation to the SERVOPACK.	–
↓			
8	Check input signals.	Check the input signals using the internal monitor function. Turn ON the power, and check that the emergency stop, brake, overtravel, and other protective functions are operating correctly.	–
↓			
9	Input servo ON signal.	Input the servo ON signal, and turn ON the linear servomotor.	Host reference
↓			
10	Input reference	Input the reference for the control mode being used, and check that the linear servomotor is operating normally.	Host reference
↓			
11	Set necessary parameters.	Run the linear servomotor from the host controller in the same way as in step 10, and set the required parameters so that the machine movement direction, movement distance, and movement speed are the same as the references.	Host reference
↓			
12	Operation	The linear servomotor can now be run. Adjust the servo gain if necessary. Refer to *5.1 Autotuning*. If an error occurs, refer to *Section 6 Inspection, Maintenance, and Troubleshooting*.	Host reference

4.2 Trial Operation Using SERVOPACK Internal References

4.2.1 SERVOPACK Setup Procedure

The setup procedures for combinations of a linear servomotor with hall sensor and those for combinations of a linear servomotor without a hall sensor are different. Use the setup procedure appropriate for the system being used.

Category	Setup procedure for linear servomotors with hall sensors	Setup procedure for linear servomotors without hall sensors
Procedure	1. Install and wire the linear servomotor and linear scale. 2. Adjust the linear scale. 3. Connect the cables. 4. Set the linear scale pitch. 5. Check the feedback signal. 6. Perform jog operation from the panel operator. 7. Set the force limit.	1. Install and wire the linear servomotor and linear scale. 2. Adjust the linear scale. 3. Connect the cables. 4. Set the linear scale pitch. 5. Select *No Hall Sensor* in the parameters. 6. Check the feedback signal. 7. Assign polarity detection start input (/P-DET). 8. Set the mass ratio. 9. Set the overtravel signal. 10. Set the force limit. 11. Check the polarity detection operation. 12. Adjust the polarity detection. 13. Perform a jog operation from the panel operator.

4.2.2 Setup Procedure Using Linear Servomotors with Hall Sensors

Perform the following steps 1 to 7 in order.

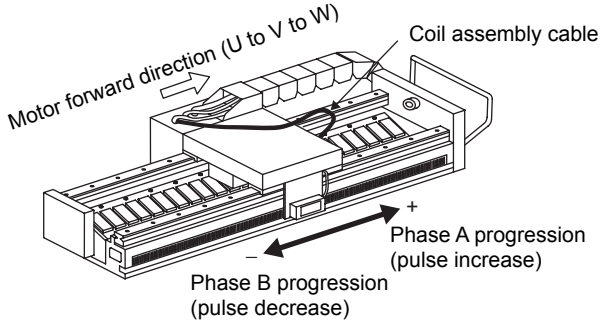
(1) Installation and Wiring of the Linear Servomotor and Linear Scale

Install the coil assembly and linear scale so that the motor forward direction and linear scale count up direction are the same.

IMPORTANT

If the motor forward direction and linear scale count up direction do not match and the linear servomotor is run in this state, the linear servomotor may not operate or overrun may occur.

When using linear Σ-series servomotors, the motor forward direction (coil assembly's movement direction when current flows through phases U, V, and W, in that order) is toward the side from which the motor cable is extended.
The analog 1-V p-p voltage input from the linear scale to the serial converter unit is counted during phase A (cos signal) progression.



INFO

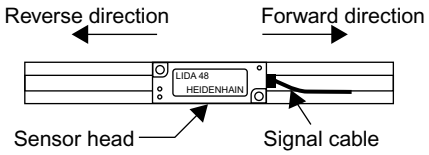
■ Motor Forward Direction and Linear Scale Count Direction Do Not Match

If the motor forward direction and linear scale count direction are opposite due to wiring or other factors, set the parameter Pn080.1=1 (B-phase progression, U, V, W-phase in order).

■ Linear Scale Count Direction

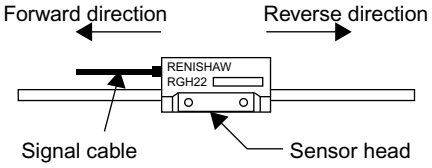
The Heidenhain or Renishaw linear scale counts pulses when the sensor head is operated to the side attached the signal cable. However, the direction in which the signal cable is extended is different, so the count direction is different. (Viewed from above).

• Heidenhain linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the right.

• Renishaw linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the left.

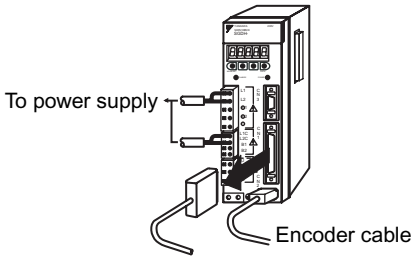
(2) Adjusting the Linear Scale

When the linear scale is an open type, adjust the head installation. For details on the adjustment method, contact the manufacturer of the scales.
When the linear scale is a sealed type, adjustment is not required. But the dimensional tolerances for installation must be maintained.

(3) Connecting the Cables

Check the power supply circuit, linear servomotor and encoder wirings. Do not connect the I/O signal connector (CN1).

For details on the linear servomotor's main circuit cable and encoder cable, refer to *2.6 Selecting Peripheral Devices*.



(4) Setting the Linear Scale Pitch (Grating)

Turn ON the control power supply.

When the power is supplied normally, the panel operator on the front panel of the SERVOPACK will show the following display. A linear scale pitch setting error (A.08) will be displayed, but does not indicate an error. Set the scale pitch (Pn280) according to the scale being used. After setting validation of the control power, the A.08 alarm will be cleared, and the settings will be enabled.

Normal status

If an alarm other than A.08 is displayed, as shown in the following diagram, the power supply circuit, linear servomotor main circuit cable or encoder cable wiring is the probable cause. Shut down the power supply, specify the location causing the alarm, and take corrective measures so that the display returns to the above normal status. For details on alarms, refer to *6.1 Troubleshooting*.

Example of alarm display

Pn280	Linear Scale Pitch		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 μm	0 μm	After restart

If the linear scale pitch (Pn280) is not set correctly, the linear servomotor cannot be controlled. Make sure that the correct value is set before operating the linear servomotor.

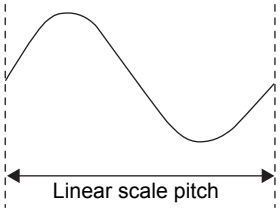
When using a SERVOPACK right after factory shipment, the alarm A.08 (Linear Scale Pitch Setting Error) will be displayed but does not indicate an error. This alarm is generated to remind the user to set Pn280. After setting the correct value and setting validation, the alarm A.08 is cleared.

Control is performed the SERVOPACK using 1/256 the distance of the scale pitch as a minimum feedback pulse. The count is performed in the serial converter unit using 1/256 of the linear scale pitch.

Make sure that the scale pitch satisfies the following conditions.

$$\text{Value of } \frac{64000}{\text{Scale pitch } (\mu m)} = \text{Integer}$$

Examples
Corrent: 1, 2, 4, 8, 10 ,16, 40
Incorrect: 3, 5, 12, 18



Linear scale pitch (Pn280) =
Distance of one cycle of the analog voltage feedback signal.

(5) Checking the Feedback Signal

Check the following feedback signals to the SERVOPACK.

- Check whether the signals from the linear scale are correctly received.
- Check whether the motor forward direction and linear scale count direction are the same.

IMPORTANT

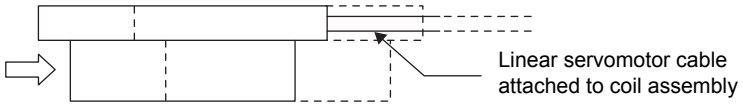
Be sure to check the feedback signals before operating the linear servomotor. If the linear servomotor is operated without checking the feedback signals, the linear servomotor may not run, or overrun may occur.

(a) Checking the Signals from the Linear Scale

1. Turn ON the control power to the SERVOPACK and set to servo OFF status.
2. Displays the monitor mode parameter Un00D (Feedback Pulse Counter) on the panel operator or digital operator.
3. Move the linear servomotor from end to end of the stroke by hand, and check whether the correct number of feedback pulses is returned.

◀ EXAMPLE ▶

Using a linear scale with a scale pitch of 20 μm, if the linear servomotor is moved only 1 cm by hand in the linear scale's count direction, the number of feedback pulses will be as follows:
1 cm/ (20 μm/256) = 12,800 pulses



When the linear servomotor is moved by hand to the side with the cable and the value of Un00D is 1F400 or FFFE0C00, confirmation is completed.

Note: The actual monitor display will deviate by the error in movement distance only, so a value that is close to the above value is acceptable.

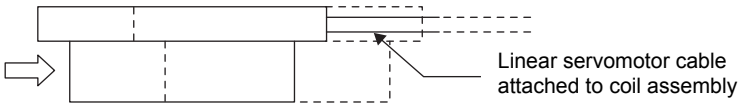
INFO

■ When the Value of the Un00D is incorrect

- If the Un00D value is not displayed correctly, the following conditions may be present. Check the conditions and take appropriate countermeasures.
- The scale pitch of the linear scale does not match.
  If the scale pitch set in Pn280 is different from the actual scale pitch, the assumed number of feedback pulses will not be returned. Check the specifications of the linear scale.
- The linear scale has not been adjusted.
  If the linear scale is not adjusted, the linear scale's output signal level will drop and the count will not be correct. Check that the linear scale is correctly adjusted. For details, contact the scale's manufacturer.
- The wiring between the linear scale and serial converter unit is not correct.
  If the wiring is not correct, a normal count will not be performed. Rewire the devices correctly.

(b) Checking the Concurrence between the Linear Scale Count Direction and the Linear Servomotor Forward Direction

Next, move the coil assembly by hand in the direction of the side with the cable, and check that the Un00D monitor is counting up.



When the linear servomotor is moved by hand to the side with the cable, if the value of Un00D is a countup value, confirmation is completed.

INFO

■ When the Value of the Un00D is counted down

When the value of the Un00D is a counted down, set the parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order). Enable the setting by setting validation.

With this setting, the SERVOPACK performs current control by treating the linear scale countup direction as the motor forward direction.

(c) Related Parameters

Pn080.1 is available for software version 32 or later.

Parameter		Description
Pn080	n.☐☐**0**☐	Phase-A progression, phase-U, V, W order (factory setting)
	n.☐☐**1**☐	Phase-B progression, phase-U, V, W order

(6) Jog Operation from the Panel Operator

IMPORTANT

When turning ON the servo for the first time after installation and wiring, stand away from the motor moving part as overrun may occur.

1. To perform a trial operation with a load attached, set mass ratio (Pn103) before running.
   When the calculated mass ratio exceeds 20000%, set 20000 in the parameter and adjust loop gains.

Pn103	Mass Ratio		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 20000 %*	1 %	0 %	Immediately

Use the following formula to obtain the mass ratio.

$$\text{Mass ratio (Pn103)} = \left(\frac{\text{Load mass (including mass of coil assembly)}}{\text{Coil assembly mass}} - 1 \right) \times 100 \ [\%]$$

* This setting range is applicable for software version 32 or later. The range for software earlier than version 32 is 0% to 10,000%.

INFO

Perform trial operations without a load attached, where possible.

2. Turn ON the control power supply and main circuit power supply.
3. Operate the panel operator or digital operator and move the linear servomotor using jog operation. For details on jog operation, refer to *3.2.3 JOG Mode Operation (Fn002)*.
4. Check that the linear servomotor moves normally from end to end of the stroke.

INFO

■ Unsuccessful Trial Operations

An unsuccessful trial operation could be attributed to the following conditions. Check the conditions and take appropriate measures.

- The load is too heavy, or the jog speed is too fast, resulting in force reference saturation.
  Set the force limit referring to *(7) Setting Force Limit*. If the force reference remains saturated, lighten the load or lower the jog speed.
- The linear servomotor is moving slightly and then stops.
  The linear servomotor, hall sensor, and linear scale are out of alignment. Check the wiring, scale pitch setting, linear scale count, and whether the motor forward direction matches the scale countup direction.
- The alarm A.C2 (phase error detection) occurs when the linear servomotor moves.
  The count direction of the linear scale signal is not correct, or the count may not be normal. Perform *(5) Checking the Feedback Signal* again.
- If the count is normal, the malfunction may be caused by noise. Check the wiring and ground conditions of the SERVOPACK, serial converter unit, and linear servomotor.

(7) Setting Force Limit

To prevent danger during setup of the linear servomotor, the factory settings for the forward force limit (Pn483) and reverse force limit (Pn484) parameters are set to small value (factory setting: 30%).
When the linear servomotor moves normally in jog operation mode, increase the value set for parameters Pn483 and Pn484 to the force required. Set the value to the maximum value if no particular restricting conditions apply.

Pn483	Forward Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	
Pn484	Reverse Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	

4.2.3 Setup Procedure Using Linear Servomotors without Hall Sensors

Perform the following steps 1 to 13.

(1) Checking Operating Conditions

Make sure that the following conditions are satisfied when performing polarity detection.

- No problems when linear servomotor is moved approximately 2 mm.
- Scale pitch must be within 100 μm (within 40 μm recommended).
- Minimum unequal external force on the linear servomotor (5% max. of rated force is recommended).
- Mass ratio less than 30 times.
- On a horizontal axis.
- Friction on the guide is a percentage of the rated force (air slide not used).

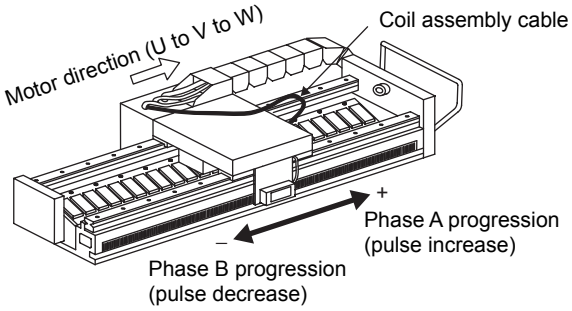
(2) Installation and Wiring the Linear Servomotor and Linear Scale

Install the coil assembly and linear scale so that the motor forward direction and linear scale count direction are the same.

IMPORTANT

If the motor forward direction and linear scale count directions do not match and the linear servomotor is run in this state, the linear servomotor may not operate or overrun may occur.

When using linear Σ-series servomotors, the motor forward direction (coil assembly's direction of progression when current flows in phase order U, V, and W) is toward the side from which the cable is extended. The analog 1-V p-p voltage input from the linear scale to the serial converter unit is counted up during phase A (cos signal) progression.



INFO

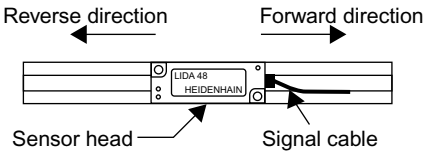
■ When Motor Forward Direction and Linear Scale Count Direction Do Not Match

When the motor forward direction and linear scale count direction are reversed due to wiring or other factors, set so that parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order).

■ Linear Scale Count Direction

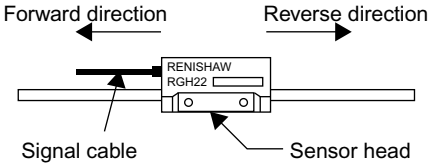
The Heidenhain or Renishaw linear scale counts pulses when the sensor head is operated to the side attached the signal cable. However, the direction in which the signal cable is extended is different, so the count direction is different. (Viewed from above).

• Heidenhain linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the right.

• Renishaw linear scale



When installed as shown in the diagram on the left, operation is performed in the forward direction when the sensor head is moved to the left.

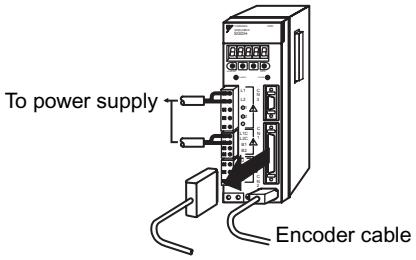
(3) Adjusting the Linear Scale

When the linear scale is an open type, adjust the head installation. For details on the adjustment method, contact the manufacturer of the scales.
When the linear scale is a sealed type, adjustment is not required. But the dimensional tolerances for installation must be maintained.

(4) Connecting the Cables

Check the power supply circuit, linear servomotor and encoder wirings. Do not connect the I/O signal connector (CN1).

For details on the linear servomotor's main circuit cable and encoder cable, refer to *2.6 Selecting Peripheral Devices*.



(5) Setting the Linear Scale Pitch

Turn ON the control power supply.

When the power is supplied normally, the panel operator on the front panel of the SERVOPACK will show the following display. A linear scale pitch setting error (A.08) will be displayed, but does not indicate an error. Set the scale pitch (Pn280) according to the scale being used. After setting validation of the control power, the A.08 alarm will be cleared, and the settings will be enabled.

Normal status

If an alarm other than A.08 is displayed, as shown in the following diagram, the power supply circuit, linear servomotor main circuit cable or encoder cable wiring is the probable cause. Shut down the power supply, specify the location causing the alarm, and take corrective measures so that the display returns to the above normal status. For details on alarms, refer to *6.1 Troubleshooting*.

Example of alarm display

Pn280	Linear Scale Pitch		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	1 μm	0 μm	After restart

If the linear scale pitch (Pn280) is not set correctly, the linear servomotor cannot be controlled. Make sure that the correct value is set before operating the linear servomotor.

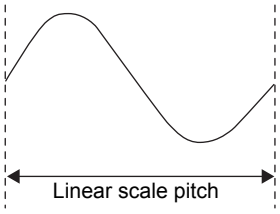
When using a SERVOPACK right after factory shipment, the alarm A.08 (Linear Scale Pitch Setting Error) will be displayed but does not indicate an error. This alarm is generated to remind the user to set Pn280. After setting the correct value and setting validation, the alarm A.08 is cleared.

Control is performed the SERVOPACK using 1/256 the distance of the scale pitch as a minimum feedback pulse. The count is performed in the serial converter unit using 1/256 of the linear scale pitch.

Make sure that the scale pitch satisfies the following conditions.

$$\text{Value of } \frac{64000}{\text{Scale pitch } (\mu m)} = \text{Integer}$$

Examples
Corrent: 1, 2, 4, 8, 10 ,16, 40
Incorrect: 3, 5, 12, 18



Linear scale pitch (Pn280) =
Distance of one cycle of the analog voltage feedback signal.

(6) Selecting No Hall Sensor

Select *No Hall Sensor* for the parameter Pn080.0. The factory setting is Pn080.0 = 0 (With hall sensor), so the setting will change to Pn080.0 = 1 (No hall sensor). The setting validation is required to enable the settings.

Parameter		Description
Pn080	n.□□□**0**	With hall sensor (factory setting)
	n.□□□**1**	No hall sensor

When Pn080.0 = 0 is set without connecting a hall sensor, the alarm A.C2 (phase error detection) alarm will occur when the power is turned ON.

(7) Checking the Feedback Signal

Check the following feedback signals to the SERVOPACK.

- Check whether the signals from the linear scale are correctly received.
- Check whether the motor forward direction and linear scale count direction are the same.

IMPORTANT

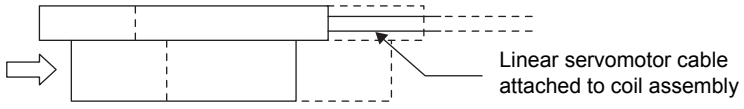
Be sure to check the feedback signals before operating the linear servomotor. If the linear servomotor is operated without checking the feedback signals, the linear servomotor may not run, or overrun may occur.

(a) Checking the Signals from the Linear Scale

1. Turn ON the control power to the SERVOPACK and set to servo OFF status.
2. Displays the monitor mode parameter Un00D (Feedback Pulse Counter) on the panel operator or digital operator.
3. Move the linear servomotor from end to end of the stroke by hand, and check whether the correct number of feedback pulses is returned.

◀ EXAMPLE ▶

Using a linear scale with a scale pitch of 20 μm, if the linear servomotor is moved only 1 cm by hand in the linear scale's count direction, the number of feedback pulses will be as follows:
1 cm/ (20 μm/256) = 12,800 pulses



When the linear servomotor is moved by hand to the side with the cable and the value of Un00D is 1F400 or FFFE0C00, confirmation is completed.

Note: The actual monitor display will deviate by the error in movement distance only, so a value that is close to the above value is acceptable.

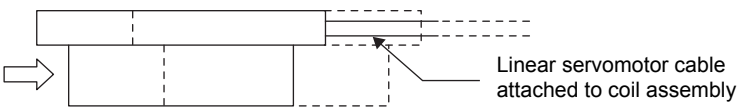
INFO

■ When the Value of the Un00D is incorrect

- If the Un00D value is not displayed correctly, the following conditions may be present. Check the conditions and take appropriate countermeasures.
- The scale pitch of the linear scale does not match.
  If the scale pitch set in Pn280 is different from the actual scale pitch, the assumed number of feedback pulses will not be returned. Check the specifications of the linear scale.
- The linear scale has not been adjusted.
  If the linear scale is not adjusted, the linear scale's output signal level will drop and the count will not be correct. Check that the linear scale is correctly adjusted. For details, contact the scale's manufacturer.
- The wiring between the linear scale and serial converter unit is not correct.
  If the wiring is not correct, a normal count will not be performed. Rewire the devices correctly.

(b) Checking the Concurrence between the Linear Scale Count Direction and the Linear Servomotor Forward Direction

Next, move the coil assembly by hand in the direction of the side with the cable, and check that the Un00D monitor is counting up.



When the linear servomotor is moved by hand to the side with the cable, if the value of Un00D is a countup value, confirmation is completed.

INFO

■ When the Value of the Un00D is counted down

When the value of the Un00D is a counted down, set the parameter Pn080.1 = 1 (B-phase progression, U, V, W-phase in order). Enable the setting by setting validation.

With this setting, the SERVOPACK performs current control by treating the linear scale countup direction as the motor forward direction.

(c) Related Parameters

Parameter		Description
Pn080	n.□□**0**□	Phase-A progression, phase-U, V, W order (factory setting)
	n.□□**1**□	Phase-B progression, phase-U, V, W order

(8) Assigning Polarity Detection Start Input (/P-DET)

When using a linear servomotor without a hall sensor, polarity detection must be performed after turning ON the power. When the input signal assignment mode is set to the factory setting (Pn50A.0=0), polarity detection starts at the same time as the Servo ON (/S-ON) signal, and when the polarity detection is completed, the Servo Ready (/S-RDY) signal turns ON.

To incorporate a sequence at the host controller that monitors the Servo Ready signal and outputs servo ON signals or to perform polarity detection using different timing from the servo ON signal, the polarity detection start signal (/P-DET) must be assigned to a user-set input.

After setting the parameter Pn50A.0 to 1 (the input signal assignments can be changed for each signal), set Pn50D.3 (/P-DET signal mapping) and assign the /P-DET signal to any input terminal. The setting validation is required to enable the settings.

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40	ON (low level)	Turning the servo ON and the polarity detection function ON (enabled).
			OFF (high level)	Turning the servo ON and the polarity detection function OFF (disabled).
	/P-DET	Must be allocated	ON (low level)	Turning the polarity detection function ON (enabled).
			OFF (high level)	Turning the polarity detection function OFF (disabled).
This input signal is used to start polarity detection. Either the /S-ON or /P-DET signal can be used to start polarity detection. When the /P-DET signal is used, input signal must be allocated. For details on assignment methods, refer to *3.3.2 Input Circuit Signal Allocation*.				

(9) Setting the mass ratio

Set the mass ratio (Pn103) before starting the polarity detection.

Pn103	Mass Ratio		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 20000 %*	1 %	0 %	Immediately

Use the following formula to obtain the mass ratio.

$$\text{Mass ratio (Pn103)} = \left(\frac{\text{Load mass (including mass of coil assembly)}}{\text{Coil assembly mass}} - 1 \right) \times 100 \ [\%]$$

* This setting range is applicable for software version 32 or later. The range for software earlier than version 32 is 0% to 10,000%.

(10) Setting the Overtravel Signal

Polarity detection cannot start in overtravel state.
When using the overtravel function, connect the signal wires and use in base block status.
When not using the overtravel function, set the parameters Pn50A.3 to 8 and Pn50B.0 to 8 (OT signal disabled).
The setting validation is required to enable the settings. For details, refer to *4.6.3 Setting the Overtravel Limit Function*.

(11) Setting Force Limit

To prevent danger during setup of the linear servomotor, the factory settings for the forward force limit (Pn483) and reverse force limit (Pn484) parameters are set to small value (factory setting: 30%).

If the force limit is set after (5) Setting the Linear Scale Pitch and (7) Checking the Feedback Signal, overrun will not occur. Increase the value in the parameters up to the required force. Set the value to the maximum value if no particular restricting conditions apply.

Pn483	Forward Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	
Pn484	Reverse Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800 %	1 %	30 %	Immediately	

INFO

If the force limit is set too high, polarity detection may not operate normally.

(12) Checking or Adjusting Polarity Detection

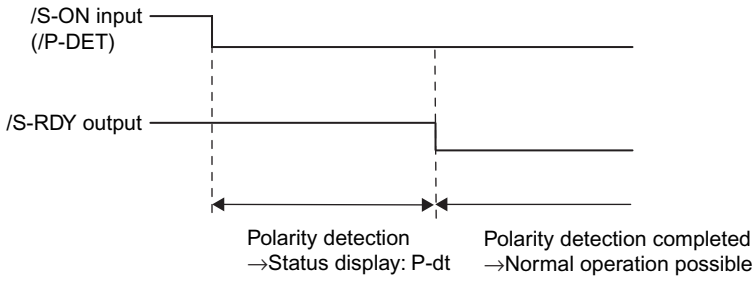
Check whether the polarity detection is operating normally.

IMPORTANT

1. The linear servomotor is turned ON during polarity detection, so take measures to avoid electric shock. The linear servomotor will make large movements during detection, so do not stand near the coil assembly.
2. Polarity detetion depends on many factors, such as mass ratio, friction, and cable tension. If any error occurs because of one of these factors, the setting may be incorrect.

(a) Polarity Detection Completion Timing

Polarity detection is performed when the /S-ON signal (/P-DET signal for /P-DET signal assignment) is input after turning ON the control power and main circuit power. During detection, the status display is *P-dt*, and the /S-RDY signal turns ON when completed.



(b) Checking whether Detection is Normal

- Simple Confirmation

After turning ON both the control power and main circuit power, input the /S-ON signal (Use /P-DET signal when using the polarity detection start signal) and perform polarity detection. When the display on the panel operator or digital operator is *bb* when the power is turned ON, the display will change to *P-dt* during polarity detection, and return to *bb* after completion.
After detection is completed, push the linear servomotor down on the stroke end and check the electrical angle in monitor mode parameter Un004 (electrical angle 2: Phase U, angle from 0°). After confirmation, remove the linear servomotor from the stroke end (10 mm min.) Then execute the setting validation, and restart polarity detection. Repeat this procedure three times. If the deviation of the electrical angle is within ±10°, the polarity detection is normal. However, the polarity detection operation will change slightly depending on the detection location, perform the following detailed check at the end.

- Detailed Confirmation

Based on the user-set position, measure the electrical angles using monitor mode parameter Un004 (electrical angle 2: Phase U, angle from 0) when polarity detection is performed at 30 points each 1.5 mm apart. If the electrical angles are in the relationship 12° ±10, the measurement results indicate the normal polarity detection.

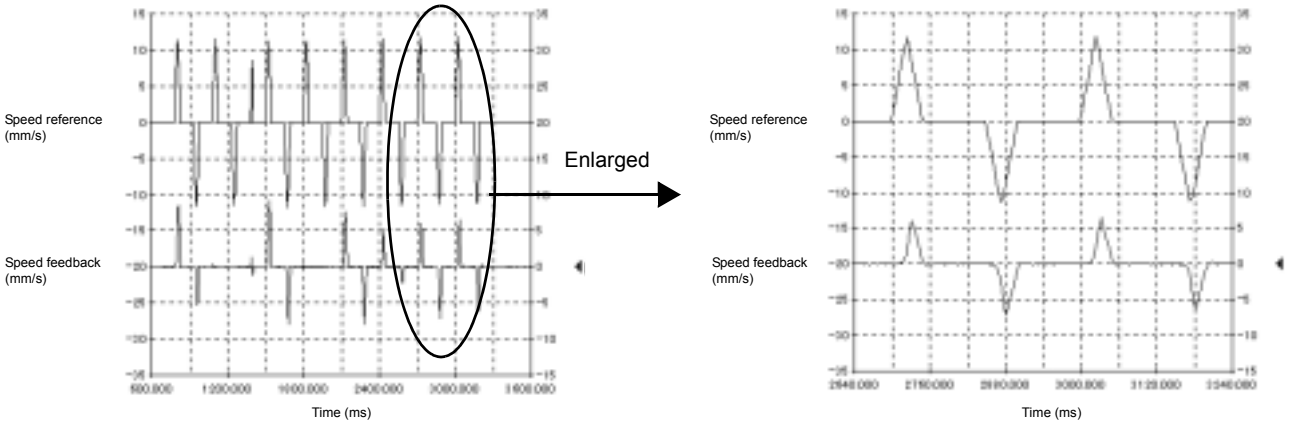
(c) Detection Waveforms

The Sigma Win+ trace function can be used to check whether detection is normal.

- Normal Detection

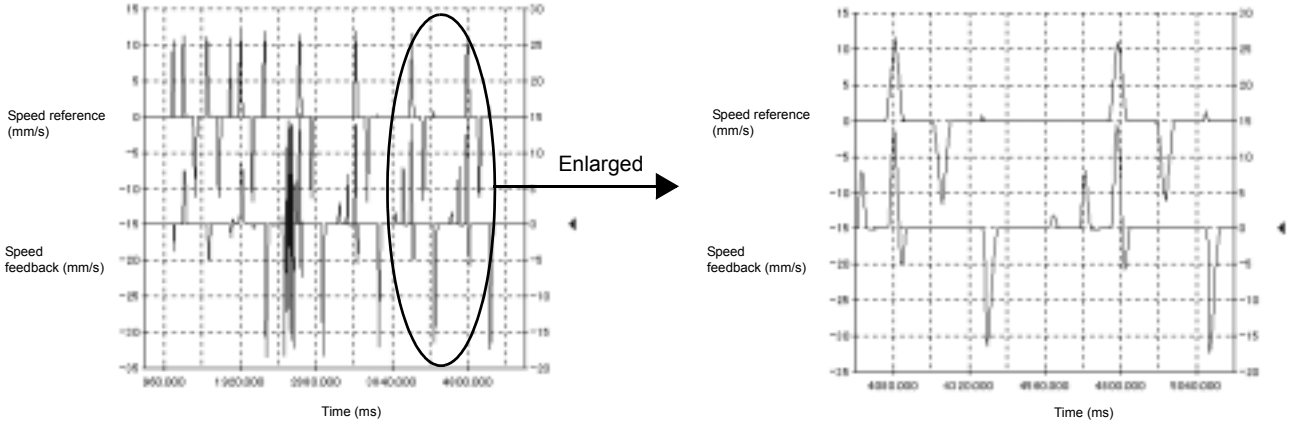
The detection result is normal if the speed feedback for the speed reference for the last detection waveform (unspecified number of detections) is traced. The following criteria are used to determine whether a trace is being performed.

- The feedback polarity is not inverse to the reference (speed is in same direction).
- The feedback speed range is 2 mm/s up to the maximum reference speed.



- Detection Error

The detection result is an error if the speed feedback for speed reference for the last detection waveform (unspecified number of detections) is not traced.



INFO

The detection waveform is not always the same, so the waveform may be different from those shown above even though the detection has completed normally.

(d) Troubleshooting for Polarity Detection Errors

Refer to the following table for troubleshooting if polarity detection is not completed normally.

No.	Problem	Cause	Countermeasure
1	The linear servomotor does not move during polarity detection (speed feedback is 0).	Polarity detection is not being performed.	Check whether the status display is *P-dt* when the /S-ON (/P-DET) signal is input. If *P-dt* is not displayed, check whether the parameters for input signal selection Pn50A and Pn50D are set correctly, and check whether signal input is being performed correctly.
		A force limit is activated.	To prevent danger during setup, the SGDH SERVOPACK's factory settings for the force limit parameters are 30%. Check the set values for Pn483 and Pn484, and change to a user-set value if the setting is initial value. Increase the value to the maximum value if no particular restrictions are required.
		The mechanical friction is large.	When the mechanical friction is relatively larger than the linear servomotor's rated force (10% or more), the linear servomotor may stop operating during polarity detection if factory settings are used. First, check whether the mass ratio (Pn103) is set correctly. If Pn103 is set correctly, increase the value set for polarity detection speed loop gain (Pn481). When the load is heavy, a large gain will cause an alarm. The gain cannot be increased under this condition, so reduce the mechanical friction. If the mechanical friction cannot be reduced without difficulty, consider using the hall sensor for polarity detection.
		Overtravel signal is detected during polarity detection.	If the OT signal is detected during polarity detection, polarity detection will be ended and the status will be returned to previous status. Before performing polarity detection, move the linear servomotor to a position where the OT signal is not detected.
2	Polarity detection error alarm (A.C5) has occurred.	Parameter settings are incorrect.	The settings for scale pitch (Pn280) and motor phase selection (Pn080.1) may not be appropriate for the device. Check the linear scale specifications and feedback signal conditions.
		Noise is present in the scale signal.	When the detection reference is repeatedly output several times in the same direction, noise may occur in the scale signal, resulting in malfunction. Check that the FG of the serial converter unit and linear servomotor is connected to FG of the SERVOPACK, and that FG of the SERVOPACK is connected to the power supply FG. Also check that the encoder cable is securely sealed.
		The coil assembly is being subjected to an external force.	If the coil assembly is subjected to an external force such as cable tension, and the speed feedback is not 0 regardless of a 0 detection reference, polarity detection will be poor. Reduce the external force and make the speed feedback 0.
		The linear scale precision is rough.	When the linear scale pitch is 100 µm min, the SERVOPACK cannot detect correct speed feedback. Use a linear scale with good scale pitch precision (within 40 µm is recommended).
		Linear servomotor traceability for the polarity detection reference is poor.	When the size of the speed feedback for the polarity detection reference is 2 mm/s max, detection may be poor. First, check that the mass ratio (Pn103) is set correctly. If Pn103 is set correctly, increase the value of polarity detection speed loop gain (Pn481). When the load is heavy, a large gain will cause an alarm. The gain cannot be increased under this condition, so reduce the mechanical friction. If the mechanical friction cannot be reduced without difficulty, consider using the hall sensor for polarity detection.
		The travel distance during polarity detection has exceeded 10 mm.	An alarm will occur if the linear servomotor movement distance exceeds 10 mm during polarity detection. The linear servomotor may have moved during detection for some reason, so check other causes and take appropriate countermeasures.

(e) Related Parameters

Parameters	Description			
Pn481	Polarity Detection Speed Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2000	1 Hz	40 Hz	Immediately
Pn482	Polarity Detection Speed Loop Time Constant		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0.15 to 512.00 ms	0.01 ms	30.00 ms	Immediately

(13) Jog Operation from the Panel Operator

After checking steps (1) to (12), perform a trial operation as follows:

Note: Perform trial operations without a load attached, if possible.

1. Turn ON the control power and main circuit power.
2. Operate the panel operator or digital operator and move the linear servomotor using jog operation. For details on jog operation, refer to *3.2.3 JOG Mode Operation (Fn002)*.

IMPORTANT

When turning ON the servo for the first time after installation and wiring, stand away from the linear servomotor as overrun may occur.

3. Check that the linear servomotor is moving normally from end to end of the stroke.

INFO

■ Unsuccessful Trial Operations

An unsuccessful trial operation could be attributed to the following conditions. Check the conditions and take appropriate measures.

- The force reference is saturated because the load is too heavy, or the jog speed is too fast.
  Lower the jog speed or lighten the load.
- The linear servomotor is moving slightly and then stops.
  The linear servomotor and linear scale are out of alignment. Check the wiring, scale pitch setting, linear scale count, and whether the motor forward direction matches the scale count direction.
- Polarity detection is not being performed normally.
  Perform step *(12) Checking or Adjusting Polarity Detection*.

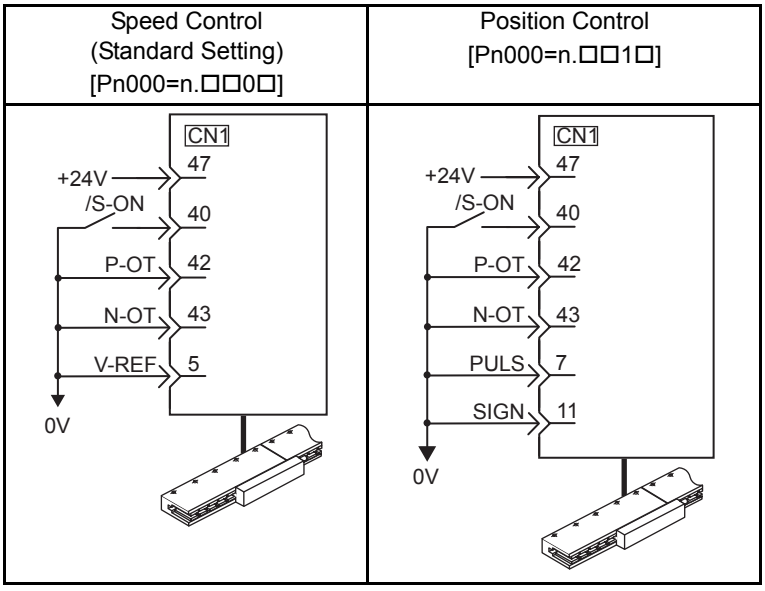
Setup is finished when all these checks have been completed.

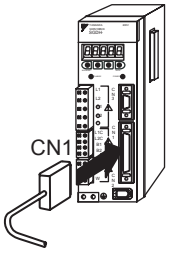
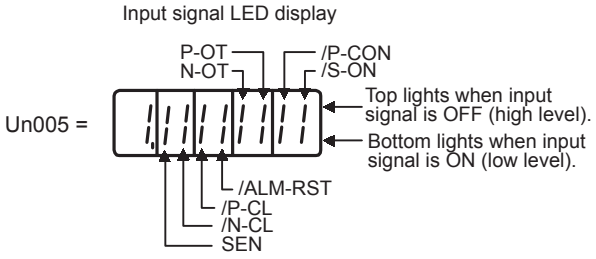
4.3 Trial Operation for Linear Servomotor without Load from Host Reference

Check that the linear servomotor move reference or I/O signals are correctly set from the host controller to the SERVOPACK. Also check that the wiring and polarity between the host controller and SERVOPACK, and the SERVOPACK operation settings are correct. This is final check before connecting the linear servomotor to the machine.

4.3.1 Servo ON Command from the Host

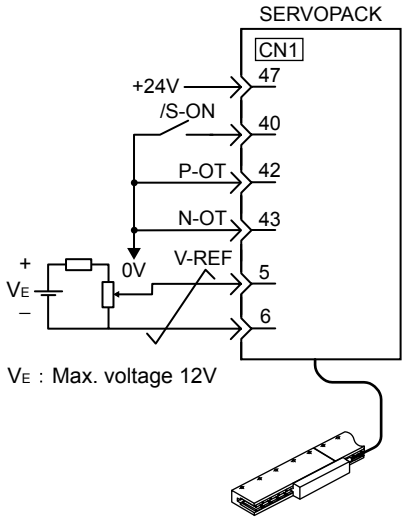
The following circuits are required: External input signal circuit or equivalent.



Step	Description	Check Method and Remarks
1	Configure an input signal circuit necessary for servo ON. Connect the I/O signal connectors (CN1) in the circuit on the previous page or equivalent to input the signal necessary for servo ON. Then turn OFF the power and connect the CN1 to the SERVOPACK. 	Satisfy the following conditions: 1. Servo ON (/S-ON) input signal can be input. 2. Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT) input signals are turned ON (L level). (Forward run and reverse run are prohibited.) 3. Reference input (0V reference or 0 pulse) is not input. To omit the external wiring, the input terminal function can be set to "Always ON" or "Always OFF" using the input signal allocation function of parameter. Refer to *3.3.2 Input Circuit Signal Allocation*.
2	Turn ON the power and make sure that the panel operator display is as shown below. 	The input signal setting is not correct if the display is not the same as on the left. Check the input signal using the Un005 (input signal monitor) from the panel operator. Un005 = Check input signal wiring in monitor mode using the digital operator or panel operator. Refer to *3.4.1 List of Monitor Modes*. Turn ON and OFF each signal line to see if the LED monitor bit display on the digital operator changes as shown below. 
3	Input the /S-ON signal, then make sure that the display of the panel operator is as shown below. 	If an alarm display appears, correct it according to *6.1 Troubleshooting*. If there is noise in the reference voltage during speed control, the horizontal line (–) at the far left edge of the panel operator display may blink. Also the linear servomotor may run very slowly.

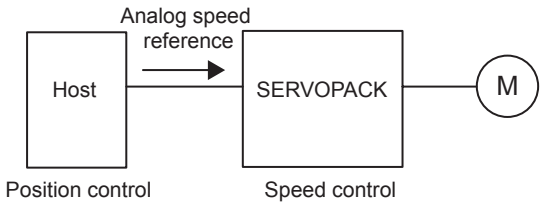
4.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)

The following circuit is required: External input signal circuit or equivalent.



Step	Description	Check Method and Remarks
1	Check the power and input signal circuits again, and check that the speed reference input (voltage between the V-REF and SG) is 0 V.	Refer to the above figure for input signal circuit.
2	Turn ON the servo ON (/S-ON) input signal.	If the linear servomotor moves with the speed reference input 0V, refer to *4.7.3 Adjusting Offset*, and use the reference voltage offset to keep the linear servomotor from moving.
3	Generally increase the speed reference input voltage between V-REF and SG from 0 V.	The factory setting is 6 V/rated speed.
4	Check the speed reference input to the SERVOPACK (Un000 [mm/s]).	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed.
5	Check the Un000 (motor speed [mm/s].	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed.
6	Check that the Un001 and Un000 values in steps 4 and 5 are equal.	Change the speed reference input voltage and check that Un001 and Un000 values are equal for multiple speed references.
7	Check the speed reference input gain and motor movement direction.	Refer to the following equation to change the Pn300 (speed reference input gain). Un001=(voltage between V-REF) [V] × Pn300 [rated speed/6V] To change the motor movement direction without changing polarity for speed reference input gain, refer to *4.6.2 Switching the Linear Servomotor Movement Direction*. Perform the operation from step 2 again after the motor rotation direction is changed.
8	When the speed reference input is set to 0 V and servo OFF status enters, the trial operation for servomotor without load is completed.	–

■ When Position Control is configured at the Host

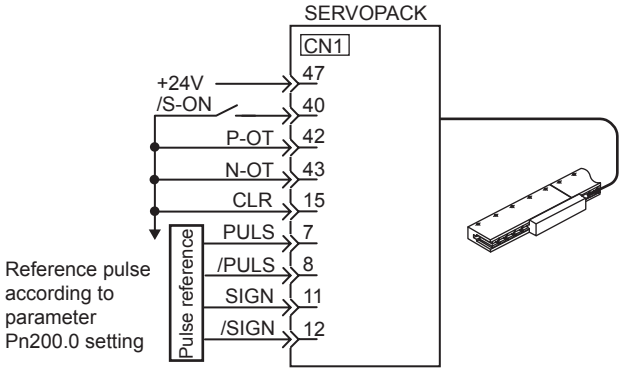


When the SERVOPACK conducts speed control and position control is conducted at the host controller, perform the operations below, following the operations in *4.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)* on the previous page.

Step	Description	Check Method and Remarks
9	Check the input signal circuit again, and check that the speed reference input (voltage between the V-REF and SG) is 0 V.	Refer to the above figure for input signal circuit.
10	Turn ON the servo ON (/S-ON) input signal.	If the linear servomotor moves at extremely slow speed, refer to *4.7.3 Adjusting Offset*, and use the reference voltage offset to keep the servomotor from moving.
11	Send the command for the movement amount easy to check (for example, 1 cm) from the host controller in advance, and check the sent movement amount and actual movement distance by visual inspection and the Un00D (feedback pulse counter)[pulse].	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed. Un00D (feedback pulse counter) [pulse]
12	If the sent movement amount and actual movement distance in step 11 are not equal, correctly set the Pn281 (PG divider) outputting the encoder pulse from the SERVOPACK.	Refer to *4.7.7 Encoder Signal Output* for how to set. Encoder output resolution (Pn281 [P/Pn280]): The number of encoder pulses per scale pitch
13	When the speed reference input is set to 0 V and servo OFF status enters, the trial operation for position control with the host controller is completed.	–

4.3.3 Operating Procedure in Position Control Mode (Pn000 = n.□□1□)

The following circuit is required: External input signal circuit or equivalent.



Step	Description	Check Method and Remarks
1	Match the reference pulse form with the pulse output form from the host controller.	Set the reference pulse with Pn200=n.□□□×. Refer to *4.8.1 (2) Setting a Reference Pulse Form*.
2	Set the reference unit and electronic gear ration so that it coincides with the host controller setting.	Set the electronic gear ratio with Pn202/Pn203. Refer to *4.8.2 Setting the Electronic Gear*.
3	Turn ON the power and the servo ON (/S-ON) input signal.	–
4	Send the pulse reference for the motor movement amount easy to check (for example, 1 cm) and with slow speed from the host controller in advance.	Set the motor speed of several 10 mm/s for the reference pulse speed because such speed is safe.
5	Check the number of reference pulses input to the SERVOPACK by the changed amount before and after the Un00C (input reference pulse counter) [pulse] was executed.	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed. Un00C (input reference pulse counter) [pulse]
6	Check the actual motor movement amount [pulse] by the change in Un00D (feedback pulse counter) [pulse] before and after executing the sent pulse reference.	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed. Un00D (feedback pulse counter) [pulse]
7	Check that steps 5 and 6 satisfy the following equation: Un00D=Un00C × (Pn202/Pn203)	–
8	Check that the motor movement direction is the same as the reference.	Check the input pulse polarity and input reference pulse form. Refer to *4.8.1 (2) Setting a Reference Pulse Form*.
9	Input the pulse reference with the bigger motor movement amount from the host controller to obtain the constant speed.	Set the motor speed of several 10 mm/s for the reference pulse speed because such speed is safe.
10	Check the reference pulse speed input to the SERVOPACK using the Un007 (input reference pulse speed) [mm/s].	Refer to *3.1.3 Basic Mode Selection and Operation* for how it is displayed. Un007 (input reference pulse speed) [mm/s]
	The number of input reference pulses (Un00C) can be obtained from the following equation. $\text{Un007 (Input reference pulse)} = \underbrace{\text{Input reference pulse [pulse/s]}}_{\text{Reference input pps}} \times \underbrace{\frac{\text{Pn202}}{\text{Pn203}}}_{\substack{\text{Electronic}\\\text{gear ratio}}} \times \underbrace{\frac{\text{Pn280}}{10^3(1000)} \times \frac{1}{2^8(256)}}_{\text{Encoder pulse}}$ * The encoder pulse differs depending on the model of the servomotor used.	

(cont'd)

Step	Description	Check Method and Remarks
11	Check the motor speed using the Un000 (motor speed) [mm/s].	Refer to3.*1.3 Basic Mode Selection and Operation* for how it is displayed. Un000 (motor speed) [mm/s]
12	Check that the Un007 and Un000 values in steps 9 and 10 are equal.	–
13	Check the motor movement direction.	To change the motor movement direction without changing input reference pulse form, refer to *4.6.2 Switching the Linear Servomotor Movement Direction*. Perform the operation from step 9 again after the motor movement direction is changed.
14	When the pulse reference input is stopped and servo OFF status enters, the trial operation for servomotor without load and using position control with the host controller is completed.	–

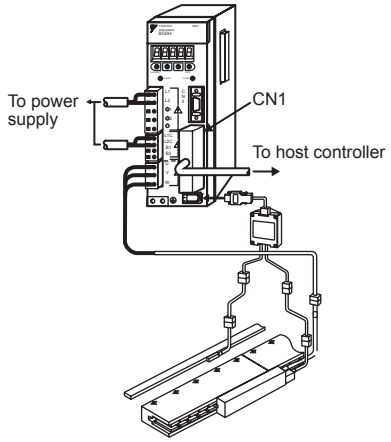
4.4 Trial Operation with the Linear Servomotor Connected to the Machine

⚠ WARNING

- Follow the procedure below for trial operation precisely as given.
  Malfunctions that occur after the linear servomotor is connected to the machine not only damage the machine, but may also cause an accident resulting death or injury.

Follow the procedures below to perform the trial operation.

1. Set the necessary parameters according to the machine configuration.
2. Match the direction of movement and speed to equipment specifications.



Step	Description	Check Method and Remarks
1	Turn ON the power and make the settings for mechanical configuration related to protective function such as overtravel and brake.	Refer to *4.6 Setting Common Basic Functions*.
2	Set the necessary parameters for control mode used.	Refer to *4.7 Operating Using Speed Control with Analog Reference*, *4.8 Operating Using Position Control*, and *4.9 Operating Using Force Control* for control mode used.
3	Check that the SERVOPACK is servo OFF status and then turn ON the power to the machine (host controller). Check again that the protective function in step 1 operates normally.	Refer to *4.6 Setting Common Basic Functions*. For steps 3 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.
4	Adjust the servo gain and improve the linear servomotor response characteristics, if necessary.	Refer to *5.1 Autotuning*. The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of additional time to ensure that it is properly broken in.
5	Write the parameters set for maintenance in *7.5 Parameter Recording Table*.	The servodrive supporting tool “Sigma Win+” serves for the file management of parameters.

4.5 Control Mode Selection

The control modes supported by the SGDH SERVOPACK are described below.

Parameter		Control Mode	Reference Section
Pn000	n.☐☐**0**☐ (Factory setting)	Speed Control (Analog voltage speed reference) Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. • To control speed • For position control using the encoder feedback division output from the SERVOPACK to form a position loop in the host controller.	4.7
	n.☐☐**1**☐	Position Control (Pulse train position reference) Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	4.8
	n.☐☐**2**☐	Force Control (Analog voltage speed reference) Controls the linear servomotor's output force by means of an analog voltage force reference. Use to output the required amount of force for operations such as pressing.	4.9
	n.☐☐**3**☐	Speed Control (Contact input speed control) Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. (In this case, an analog reference is not necessary.)	4.10
	n.☐☐**4**☐ . . . n.☐☐**B**☐	These are switching modes for using the four control methods described above in combination. Select the control method switching mode that best suits the application.	4.12

4.6 Setting Common Basic Functions

4.6.1 Setting the Servo ON Signal

This sets the servo ON signal (/S-ON) that determines whether the servomotor power is ON or OFF.

(1) Servo ON signal (/S-ON)

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40 (Factory setting)	ON (low level)	Linear servomotor power ON. Linear servomotor can be operated.
			OFF (high level)	Linear servomotor power OFF. Linear servomotor cannot be operated.

■ IMPORTANT

Always input the servo ON signal before inputting the input reference to start or stop the linear servomotor. Do not input the input reference first and then use the /S-ON signal to start or stop. Doing so will degrade internal elements and lead to malfunction.

Note: A parameter can be used to re-allocate the input connector number for the /S-ON signal. Refer to *3.3.2 Input Circuit Signal Allocation.*

(2) Enabling/Disabling the Servo ON Signal

A parameter can be always used to set a parameter servo ON condition. This eliminates the need to wire /S-ON, but care must be taken because the SERVOPACK can operate as soon as the power is turned ON.

Parameter		Meaning
Pn50A	n.□□**0**□	Inputs the /S-ON signal from the input terminal CN1-40. (Factory setting)
	n.□□**7**□	Constantly enables the /S-ON signal.

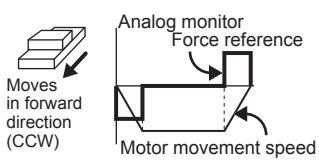
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- When the parameter is set to constantly "enable" the signal, resetting an alarm can only be done by turning the power OFF and ON. (Alarm reset is disabled.)

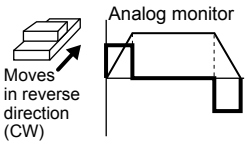
4.6.2 Switching the Linear Servomotor Movement Direction

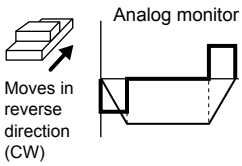
The movement direction of the linear servomotor can be switched without changing the reference pulse to the SERVOPACK or the reference voltage polarity.

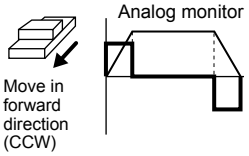
This causes the travel direction (+, -) of the shaft reverse. The output signal polarity such as encoder pulse output and analog monitor signal from the SERVOPACK does not change.

The standard setting for "forward movement" is the linear scale counting up direction.

<table>
<tr><th colspan="2" rowspan="2">Parameter</th><th rowspan="2">Name</th><th colspan="2">Reference</th></tr>
<tr><th>Forward Reference</th><th>Reverse Reference</th></tr>
<tr><td>Pn000</td><td>n.□□□0</td><td>Standard setting
(CCW = Forward)
(Factory setting)</td><td> 

Encoder pulse divided output
PAO
PBO Phase B progression</td><td> 

Encoder pulse devided output
PAO Phase A progression
PBO</td></tr>
<tr><td></td><td>n.□□□1</td><td>Reverse Direction Mode
(CW = Reverse)</td><td> 

Encoder pulse divided output
PAO
PBO Phase B progression</td><td> 

Encoder pulse divided output
PAO Phase A progression
PBO</td></tr>
<tr><td colspan="5">The direction of P-OT and N-OT change. For Pn000 = n.□□□0 (standard setting), counterclockwise is P-OT. For Pn000 = n.□□□1 (Reverse Direction Mode), clockwise is P-OT.</td></tr>
</table>

4.6.3 Setting the Overtravel Limit Function

The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion and turn ON a limit switch.

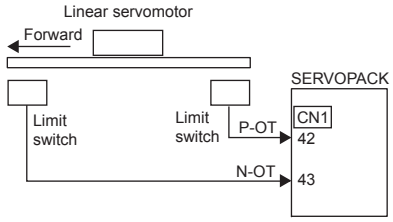
(1) Connecting the Overtravel Signal

To use the overtravel function, connect the following overtravel limit switch input signal terminals.

Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-42 (Factory setting)	ON (low level)	Forward run allowed. Normal operation status.
			OFF (high level)	Forward run prohibited. Forward overtravel.
Input	N-OT	CN1-43 (Factory setting)	ON (low level)	Reverse run allowed. Normal operation status.
			OFF (high level)	Reverse run prohibited. Reverse overtravel.

Connect limit switches as shown below to prevent damage to the devices during linear motion.

Movement in the opposite direction is possible during overtravel. For example, reverse run is possible during forward overtravel



■ IMPORTANT

When the linear servomotor stops due to overtravel during position control, the position error pulses are held. A clear signal (/CLR) input is required to clear the error pulses.

(2) Enabling/Disabling the Overtravel Signal

A parameter can be set to disable the overtravel signal. If the parameter is set, there is no need to wire the overtravel input signal.

Parameter		Meaning
Pn50A	n.**2**□□□	Inputs the Forward Run Prohibited (P-OT) signal from CN1-42. (Factory setting)
	n.**8**□□□	Disables the Forward Run Prohibited (P-OT) signal. (Allows constant forward run.)
Pn50B	n.□□□**3**	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-43. (Factory setting)
	n.□□□**8**	Disables the Reverse Run Prohibited (N-OT) signal. (Allows constant reverse run.)

- Applicable control methods: Speed control, position control, and force control
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.

* A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to *3.3.2 Input Circuit Signal Allocation*.

(3) Selecting the Motor Stop Method When Overtravel is Used

This is used to set the stop method when an overtravel (P-OT, N-OT) signal is input while the motor is operating.

Parameter		Stop Mode	Mode After Stopping	Meaning
Pn001	n.☐☐**00**	Stop by dynamic brake	Dynamic Brake	Stops the linear servomotor by applying dynamic brake (DB), then holds it in Dynamic Brake Mode. (Factory setting)
	n.☐☐**01**☐		Coast	Stops the linear motor by applying dynamic brake, then places it into Coast (power OFF) Mode.
	n.☐☐**02**☐	Coast to a stop		Coasts the linear motor to a stop, then places it into Coast (power OFF) Mode.
	n.☐☐**1**☐	Decelerate to stop	Zero Clamp	Decelerates the linear servomotor with emergency stop force (Pn406), then places it into Zero Clamp (Servolock) Mode.
	n.☐☐**2**☐		Coast	Decelerates the linear servomotor with emergency stop force (Pn406), then places it into Coast (power OFF) Mode.

- During force control, linear servomotor will be placed in Coast Mode after stopping regardless of the setting of Pn001.1.
- After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
- During n.☐☐02 Coast Mode, SERVOPACK can be resumed using the servo ON signal.

■ TERMS

- Stop by dynamic brake: Stops by using the dynamic brake (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.
- Decelerate to stop: Stops by using deceleration (braking) force.
- Zero Clamp Mode: A mode forms a position loop by using the position reference zero.

* For details on stopping methods when the servo turns OFF or when an alarm occurs, refer to *4.6.4 Selecting the Stopping Method After Servo OFF*.

(4) Setting the Stop Force for Overtravel

Pn406	Emergency Stop Force		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800	%	800	Immediately	

- This sets the stop force for when the overtravel signal (P-OT, N-OT) is input.
- The setting unit is a percentage of the rated force (i.e., the rated force is 100%).
- The value large enough to be the motor maximum force, 800% is set as the factory setting for emergency stop force. However, the actual output emergency stop force is determined by motor ratings.

4.6.4 Selecting the Stopping Method After Servo OFF

The stopping method when the power to the SERVOPACK turns OFF can be selected.

Parameter		Stop Mode	Mode After Stopping	Meaning
Pn001	n.□□□**0**	Stop by dynamic brake	Dynamic Brake	Stops the linear servomotor by dynamic braking (DB), then holds it in Dynamic Brake Mode. (Factory setting)
	n.□□□**1**		Coast	Stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.
	n.□□□**2**	Coast to a stop	Coast	Stops the servomotor by coasting, then places it into Coast (power OFF) Mode.

These parameters are valid under the following conditions:

- When the /S-ON input signal is OFF (Servo OFF).
- When an alarm occurs.
- When main circuit power supply (L1, L2, L3) is OFF. (Some linear servomotor models are forcibly stopped by dynamic braking.)

Similar to the Coast Mode, the n.□□□0 setting (which stops the servomotor by dynamic braking and then holds it in Dynamic Brake Mode) does not generate any braking force when the servomotor stops or when it runs at very low speed.

■ TERMS

- Stop by dynamic brake: Stops by using the dynamic brake (with short-circuiting by a circuit of SERVOPACK).
- Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the motor in operation.

■ IMPORTANT

The linear servomotor is **forced to stop by dynamic braking, regardless of the settings of this parameter**, when the main circuit power supply (L1, L2, L3) or control power supply (L1C, L2C) turns OFF.

- SGDH-A5AE to -15AE (50 W to 1.5 kW for 200 V)
- SGDH-10DE to -75DE (1.0 kw to 7.5 kW for 400 V)

If the linear servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply (L1, L2, L3) or the control power supply (L1C, L2C) turns OFF, arrange the sequence externally so the linear servomotor wiring (U, V, W) will be interrupted.

IMPORTANT

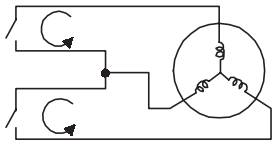
The dynamic brake (DB)[1] is an emergency stop function.

If the servomotor is frequently started and stopped by turning the power ON/OFF or using the servo ON signal (/S-ON), the DB circuit will also be repeatedly operated, degrading the SERVOPACK's internal elements. Use the speed input reference and position reference to control the starting and stopping of the servomotor.

TERMS

[1] Dynamic brake (DB)

A common method for quickly stopping a servomotor. The servomotor is stopped by short-circuiting the servomotor circuit. This circuit is built into the SERVOPACK.



4.6.5 Instantaneous Power Loss Settings

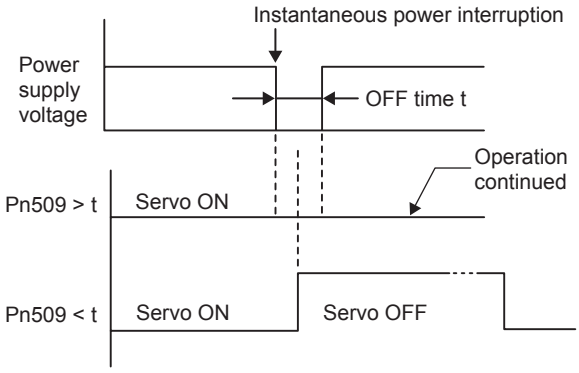
Determines whether to continue operation or turn the servo OFF when the power supply voltage to the SERVOPACK main circuit is instantaneously interrupted.

Pn509	Instantaneous Power Cut Hold Time		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	20 to 1000	ms	20	Immediately	

In power loss detection, the status of the main circuit power supply is detected and OFF status is ignored so servomotor operation will continue if the servomotor turns back ON within the time set in parameter Pn509.

In the following instances, however, the parameter setting will be invalid.

- If an insufficient voltage alarm (A.41) occurs during a power loss with a large servomotor load.
- When control is lost (equivalent to normal power OFF operation) with loss of the control power supply.



■ IMPORTANT

The maximum setting for the hold time during a power loss is 1,000 ms, but the hold time for the SERVOPACK control power supply is about 100 ms. The hold time for the main circuit power supply depends on the SERVOPACK output.

To continue SERVOPACK operation for a power loss that is longer than this, provide an uninterruptible power supply.

4.6.6 Motor Maximum Speed (For the software version 32 or later)

Sets the linear servomotor maximum speed.

Setting a lower speed realizes more delicate speed control and more strict protection by generating the overspeed alarm (A.51.) Also, setting a lower speed allows the upper limit of PG divider (Pn281) to be set higher. Refer to *4.7.7 Encoder Signal Output* for details.

Pn384	Motor Maximum Speed		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	1 to 50 (0.1 to 5.0 m/s)	0.1 m/s	50	After Restart	

- If a value lower than the rated speed is set for Pn384, the rated speed becomes the same value as the setting of Pn384.
- The detection level for the overspeed alarm A.51 is "the set value of Pn384 × 1.1."

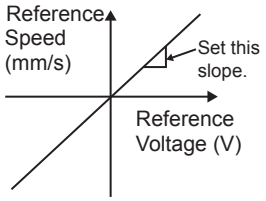
4.7 Operating Using Speed Control with Analog Reference

4.7.1 Setting Parameters

Parameter		Description
Pn000	n.□□**0**□	Control mode selection: Speed control (analog reference) (factory setting)

Pn300	Speed Reference Input Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	6.00 V/Rated speed	Immediately

Sets the analog voltage level for the speed reference (V-REF) necessary to operate the linear servomotor at the rated speed.



■ EXAMPLE

Pn300=6.00: 6-V input is equivalent to the rated speed of the servomotor (factory setting).

Pn300=10.00: 10-V input is equivalent to the rated speed of the servomotor.

Pn300=2.00: 2-V input is equivalent to the rated speed of the servomotor.

4.7.2 Setting Input Signals

(1) Speed Reference Input

Input the speed reference to the SERVOPACK using the analog voltage reference to control the linear servomotor speed in proportion to the input voltage.

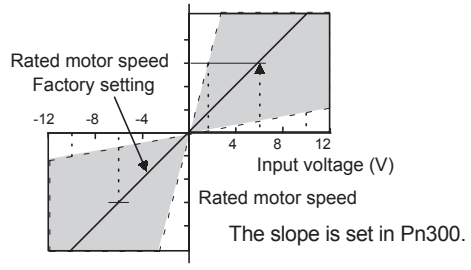
Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed Reference Input
	SG	CN1-6	Signal Ground for Speed Reference Input

The above inputs are used for speed control (analog voltage reference). (Pn000.1 = 0, 4, 7, 9, or A)

Pn300 is used to set the speed reference input gain. Refer to *4.7.1 Setting Parameters*.

■ Input Specifications

- Input range: ±2 VDC to ±10 VDC/rated speed
- Maximum allowable input voltage: ±12 VDC



- Setting Example

  Pn300 = 600: Rated speed at ±6 V

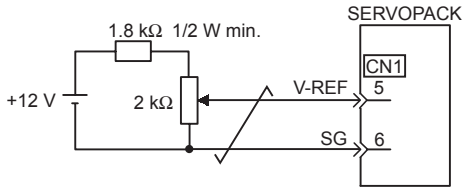
  Actual examples are shown below.

Speed Reference Input	Movement Direction	Motor Speed	SGLGW Linear Servomotor
+6 V	Forward	Rated motor speed	1500 mm/s
+1 V	Forward	(1/6) rated motor speed	250 mm/s
-3 V	Reverse	(1/2) rated motor speed	750 mm/s

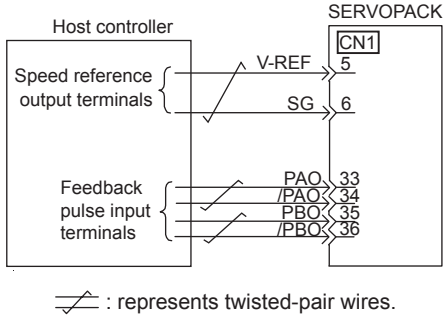
Parameter Pn300 can be used to change the voltage input range.

■ Input Circuit Example

- Always use twisted-pair wire to control noise.
- Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.



Connect V-REF and SG to the speed reference output terminals on the host controller when using a host controller, such as a programmable controller, for position control.



(2) Proportional Control Reference (/P-CON)

Type	Signal Name	Connector Pin Number	Setting	Description
Input	/P-CON	CN1-41	ON (low level)	Operates the SERVOPACK with proportional control.
			OFF (high level)	Operates the SERVOPACK with proportional integral control.

/P-CON signal selects either the PI (proportional integral) or P (proportional) Speed Control Mode.

Switching to P control reduces linear servomotor movement and minute vibrations due to speed reference input drift.

Input reference: At 0 V, the servomotor rotation due to drift will be reduced, but servomotor rigidity (holding force) drops when the servomotor is stopped.

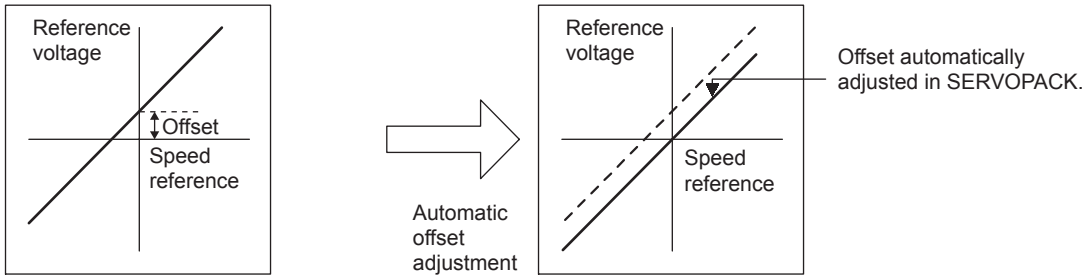
Note: A parameter can be used to reallocate the input connector number for the /P-CON signal. Refer to *3.3.2 Input Circuit Signal Allocation*.

4.7.3 Adjusting Offset

When using the speed control, the servomotor may run slowly even if 0 V is specified as the analog voltage reference. This happens if the host controller or external circuit has a slight offset (in the units of mV) in the reference voltage. Adjustments can be done manually or automatically by using the panel operator or digital operator. Refer to *3.2 Operation in Utility Function Mode (Fn□□□)*.

The automatic adjustment of the analog (speed, force) reference offset (Fn009) automatically measures the amount of the offset and adjusts the reference voltage.

The SERVOPACK automatically adjusts the offset when the host controller or external circuit has the offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK. The amount of offset can be checked in the speed reference offset manual adjustment mode (Fn00A).

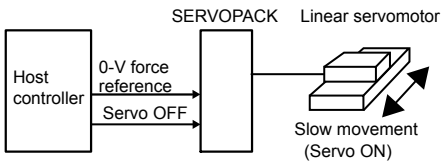
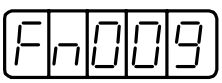
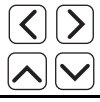
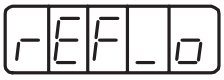
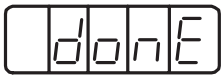
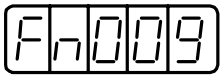
(1) Automatic Adjustment of the Speed Reference Offset

The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. Use the speed reference offset manual adjustment (Fn00A) described in the next section for a position loop.

The zero-clamp speed control function can be used to force the motor to stop while the zero speed reference is given. Refer to *4.7.6 Using the Zero Clamp Function*.

IMPORTANT The speed reference offset must be automatically adjusted with the servo OFF.

Adjust the speed reference offset automatically in the following procedure.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1				Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3				Press the LEFT/RIGHT or UP/DOWN Key, or UP or DOWN Key to select parameter Fn009. *The digit that can be set will blink.
4		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. “rEF_o” will be displayed.
5		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The reference offset will be automatically adjusted. When completed, “donE” will blink for about one second.
6		About one second later		After “donE” is displayed, “rEF_o” will be displayed again.
7		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn009 display of the utility function mode.

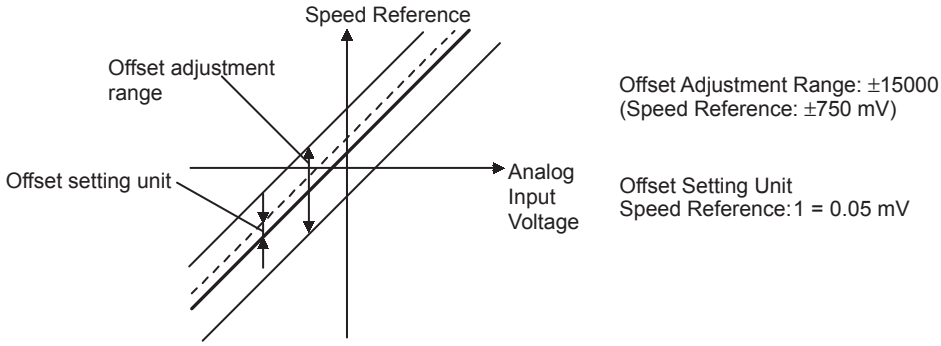
(2) Manual Adjustment of the Speed Reference Offset

Use the speed reference offset manual adjustment (Fn00A) in the following situations:

- If a loop is formed with the host controller and the position error pulse is to be zero when servolock is stopped.
- To deliberately set the offset to some value.
- To check the offset data set in the speed reference offset automatic adjustment mode.

This function operates in the same way as the reference offset automatic adjustment mode (Fn009), except that the amount of offset is directly input during the adjustment.

The offset setting range and setting units are as follows:



Adjust the speed reference offset manually in the following procedure.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL/SET (DSPL/SET Key)	MODE/SET (MODE/SET Key	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00A	∧ ∨	∧ ∨	Press the UP or DOWN Key to select parameter Fn00A. *The digit that can be set will blink.
3	-.-SPd	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will be as shown at the left. The manual adjustment mode for the speed reference offset will be entered.
4	-.-SPd	Servo ON		Turn ON the servo ON (/S-ON) signal. The display will be as shown at the left.
5	0000	< >	DATA/◀ (DATA/SHIFT Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to display the speed reference offset amount.
6		∧ ∨	∧ ∨	Press the UP or DOWN Key to adjust the amount of offset.
7	-.-SPd	< >	MODE/SET (MODE/SET Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or MODE/SET Key for less than one second. The display will appear momentarily as shown at the left, and "donE" will blink and the offset will be set. After the setting is completed, the display will return to the display as shown at the left.
8	Fn00A	DATA/ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn00A display of the utility function mode.

4.7.4 Soft Start

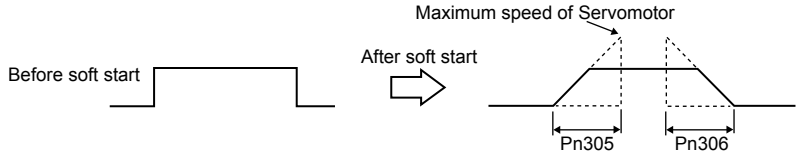
The soft start function converts the stepwise speed reference inside the SERVOPACK to a consistent rate of acceleration and deceleration.

Pn305	Soft Start Acceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	ms	0	Immediately
Pn306	Soft Start Deceleration Time		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	ms	0	Immediately

The soft start function enables smooth speed control when inputting a stepwise speed reference or when selecting internally set speeds. Set both Pn305 and Pn306 to "0" for normal speed control.

Set these parameters as follows:

- Pn305: The time interval from the time the motor starts until the motor maximum speed is reached.
- Pn306: The time interval from the time the motor is operating at the motor maximum speed until it stops.



4.7.5 Speed Reference Filter

Pn307	Speed Reference Filter Time Constant		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65535	0.01 ms	40	Immediately

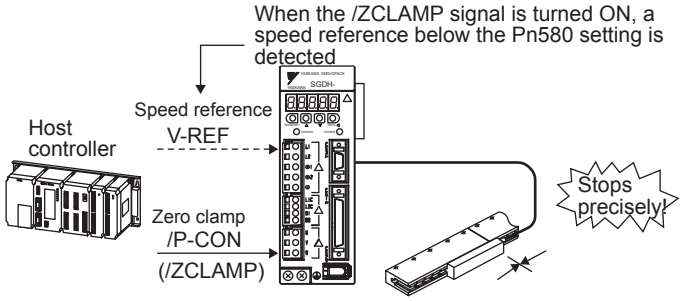
This smoothens the speed reference by applying a 1st-order delay filter to the analog speed reference (V-REF) input. A value that is too large, however, will slow down response.

4.7.6 Using the Zero Clamp Function

(1) Zero Clamp Function

The zero clamp function is used for systems where the host controller does not form a position loop for the speed reference input. When the zero clamp signal (/ZCLAMP) is ON, a position loop is formed inside the SERVOPACK as soon as the input voltage of the speed reference (V-REF) drops below the motor speed level in the zero clamp level (Pn580). The servomotor ignores the speed reference and then quickly stops and locks the servomotor.

The servomotor is clamped within ±1 pulse of when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly moved by external force.



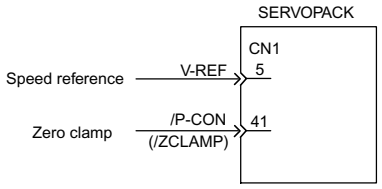
(2) Parameter Setting

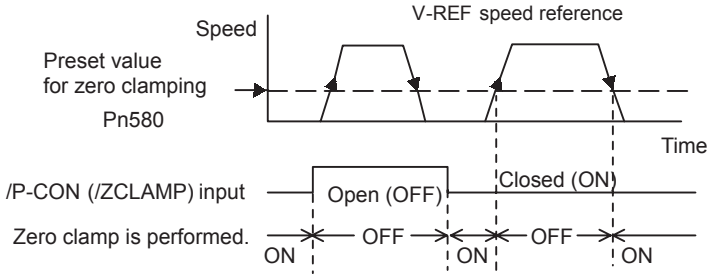
Parameter		Meaning
Pn000	n.☐☐**A**☐	Control mode selection: Speed control (analog voltage reference) ⇔ Zero clamp

Zero Clamp Conditions

Zero clamp is performed with Pn000 = n.☐☐A☐ when the following two conditions are satisfied:

- /P-CON (/ZCLAMP) is ON (low level).
- Speed reference (V-REF) drops below the setting of Pn580.





Pn580	Zero Clamp Level		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10000	1 mm/s	10	Immediately

Sets the motor speed at which the zero clamp is performed if zero clamp speed control (Pn000 = n.☐☐A☐) is selected. Even if this value is set higher than the maximum speed of the servomotor, the maximum speed will be used.

(3) Input Signal Setting

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41	ON (low level)	Zero clamp function ON (enabled)
			OFF (high level)	Zero clamp function OFF (disabled)
	/ZCLAMP	Must be allocated	ON (low level)	Zero clamp function ON (enabled)
			OFF (high level)	Zero clamp function OFF (disabled)

This is the input signal for the zero clamp operation.

Either /P-CON or /ZCLAMP can be used to switch the zero clamp.

To use the /ZCLAMP signal, an input signal must be allocated. Refer to *4.3.2 Input Circuit Signal Allocation* for more details.

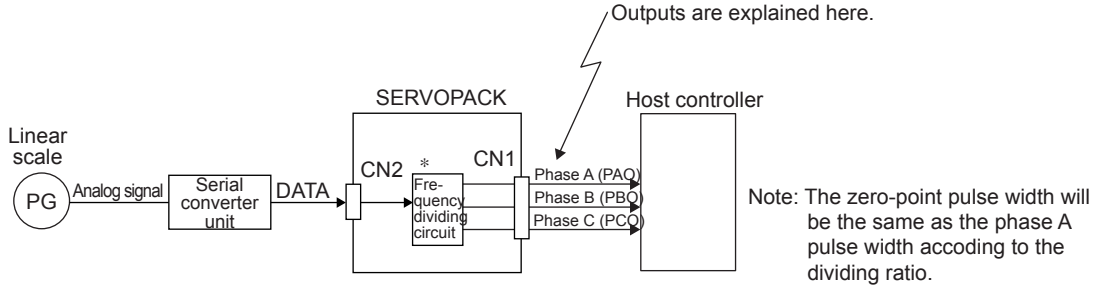
■ IMPORTANT

When the /ZCLAMP signal is allocated, the zero clamp operation will be used even for speed control Pn000 = n.☐☐0☐.

4.7.7 Encoder Signal Output

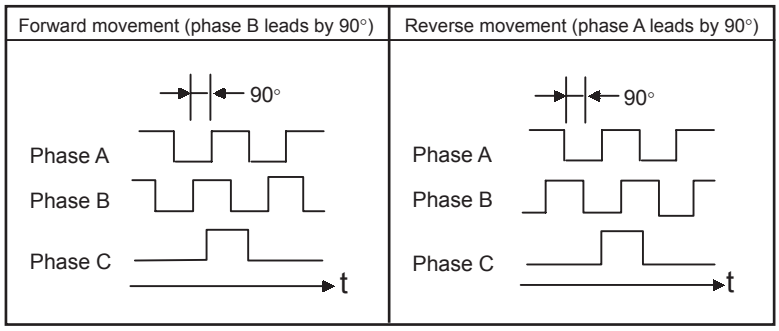
Encoder feedback pulses processed inside the SERVOPACK can be output externally.

Type	Signal Name	Connector Pin Number	Name
Output	PAO	CN1-33	Encoder output phase A
	/PAO	CN1-34	Encoder output phase /A
Output	PBO	CN1-35	Encoder output phase B
	/PBO	CN1-36	Encoder output phase /B
Output	PCO	CN1-19	Encoder output phase C (zero-point pulse)
	/PCO	CN1-20	Encoder output phase /C (zero-point pulse)



* Even in reverse movement mode (Pn000.0 = 1), the dividing output phase form is the same as that for the standard setting (Pn000.0 = 0).

■ Output Phase Form



IMPORTANT

- When returning the machine to its home position by using the zero-point signal of linear scale, the home return speed should be 50 mm/s or less. If the speed is higher than 50 mm/s, the phase C pulse may not be output correctly.
- When using a linear scale with more than one zero-point signal, the phase C pulse width of 2nd and onward zero-point signal will be half of the phase A pulse width.
- When using the zero-point signal of linear scale manufacture by RENISHAW, the phase C pulse is output at two positions after passing the first zero-point. This is not an error. And, the phase C pulse width of 2nd zero-point will be half of the phase A pulse width.

TERMS

Dividing

The dividing means that the divider converts data into the pulse density set in th parameter Pn281, on the base of the scale pitch of linear scale installed on the linear servomotor, and outputs it. The setting unit is the number of edges/scale pitch.

- Pulse Dividing Ratio Setting

Pn281	Encoder Output Resolution		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 225P/{Pn280)×4}	1P/{(Pn280)×4}	20P/{(Pn280)×4}	After restart

Set the output pulse resolution for PG output signals (PAO, /PAO, PBO, /PBO) externally from the SERVOPACK.
Feedback pulses per linear scale pitch (Pn280) are divided inside the SERVOPACK by the value set in Pn281 before being output. (Set according to the system specifications of the machine or host controller.)
The setting range varies with the linear servomotor maximum speed (Pn384) and linear scale pitch (Pn280). Refer to the table below for details.

Scale Pitch (Pn280) (μm)	Motor Max. Speed (Pn384) (m/s)	Encoder Output Resolution (Pn281)
40	5	1 to 63
	4	64 to 127
	2	128 to 255
20	5	1 to 31
	4	32 to 63
	2	64 to 127
	1	128 to 255
4	1	1 to 31
	0.8	32 to 63
	0.4	64 to 127
	0.2	128 to 255

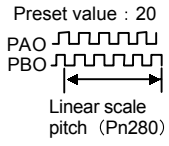
Note: 1. When the scale pitch is 4 μm, the motor maximum speed is limited to 1 m/s because of the maximum response frequency of serial converter unit.
2. The SERVOPACK with the software version 32 or higher outputs the alarm "Dividing Pulse Output Setting Error (A.09)" if the set value does not satisfy the above setting range or the setting conditions.
The SERVOPACK with the sofware version before 32 cannot output correctly the divided pulses if the set value does not satisfy the above setting range or the setting condition.
3. The upper limit of encoder output resolution is limited by the frequency dividing specification of serial converter unit.

■ Setting Example

When the linear scale pitch = 20 μm and the motor maximum speed = 5 m/s,
Pn281 = 31 is accepted, but Pn281 = 32 is not accepted and A.09 is output.

■ Output Example

When Pn281 = 20 (20-edge output (5-pulse output) per linear scale pitch),



4.7.8 Speed Coincidence Output

The speed coincidence (/V-CMP) output signal is output when the actual motor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-25, 26 (Factory setting)	ON (low level)	Speed coincides.
			OFF (high level)	Speed does not coincide.
This output signal can be allocated to another output terminal with parameter Pn50E. Refer to *3.3.3 Output Circuit Signal Allocation* for details.				

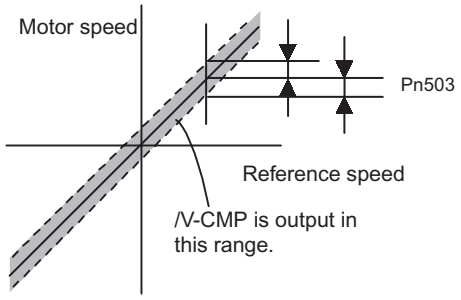
Pn582 Speed Coincidence Signal Output Width [Speed]

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 100	1 mm/s	10	Immediately

The /V-CMP signal is output when the difference between the speed reference and actual motor speed is the same as the pn582 setting or less.

■ EXAMPLE

The /V-CMP signal turns ON at 1900 to 2100 mm/s if the Pn582 is set to 100 and the reference speed is 2000 mm/s.



/V-CMP is a speed control output signal. When the factory setting is used and the output terminal allocation is not performed with the Pn50E, this signal is automatically used as the positioning completed signal /COIN for position control, and it is always OFF (high level) for torque control.

4.8 Operating Using Position Control

4.8.1 Setting Parameters

Set the following parameters for position control using pulse trains.

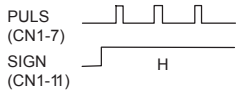
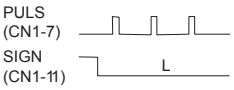
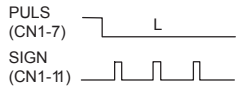
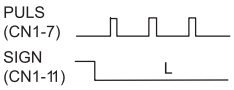
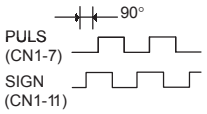
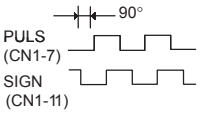
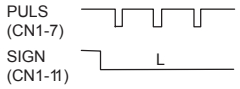
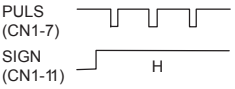
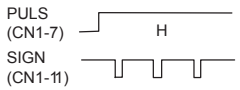
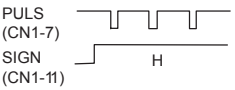
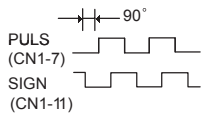
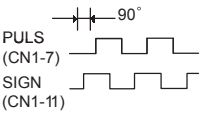
(1) Control Mode Selection

Parameter		Meaning
Pn000	n.□□**1**□	Control mode selection: Position control (pulse train reference)

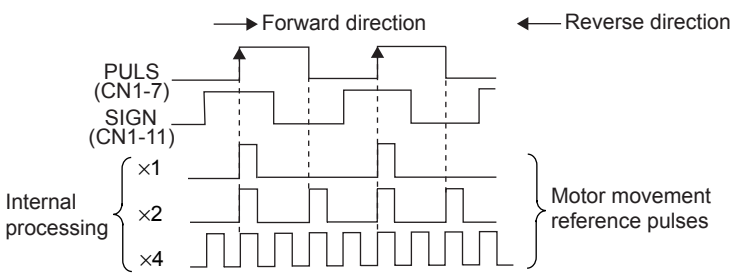
(2) Setting a Reference Pulse Form

Type	Signal Name	Connector Pin Number	Name
Input	PULS	CN1-7	Reference Pulse Input
	/PULS	CN1-8	Reference Pulse Input
	SIGN	CN1-11	Reference Code Input
	/SIGN	CN1-12	Reference Code Input

Set the input form for the SERVOPACK using parameter Pn200.0 according to the host controller specifications.

Parameter		Reference Pulse Form	Input Pulse Multiplier	Forward Movement Reference	Reverse Movement Reference
Pn200	n.□□□**0**	Sign + pulse train (Positive logic) (Factory setting)	−		
	n.□□□**1**	CW pulse + CCW pulse (Positive logic)	−		
	n.□□□**2**	Two-phase pulse train with 90° phase differential (Positive logic)	×1		
	n.□□□**3**		×2		
	n.□□□**4**		×4		
	n.□□□**5**	Sign + pulse train (Negative logic)	−		
	n.□□□**6**	CW pulse + CCW pulse (Negative logic)	−		
	n.□□□**7**	Two-phase pulse train with 90° phase differential (Negative logic)	×1		
	n.□□□**8**		×2		
	n.□□□**9**		×4		

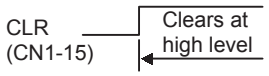
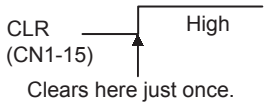
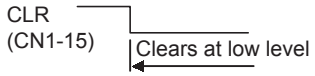
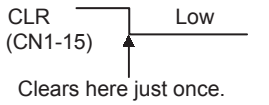
The input pulse multiplier can be set for the 2-phase pulse train with 90° phase differential reference pulse form.



(3) Clear Signal Form Selection

Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-15	Clear Input
	/CLR	CN1-14	Clear Input

The internal processing of the SERVOPACK for the clear signal can be set to either of four types by parameter Pn200.1. Select according to the specifications of the machine or host controller.

Parameter		Description	Timing
Pn200	n.☐☐**0**☐	Clears at high level. Position error pulses do not accumulate while the signal is at high level. (Factory setting)	
	n.☐☐**1**☐	Clears at the rising edge.	
	n.☐☐**2**☐	Clears at low level. Position error pulses do not accumulate while the signal is at low level.	
	n.☐☐**3**☐	Clears at the falling edge.	

The following are executed when the clear operation is enabled.

- The SERVOPACK error counter is set to 0.
- Position loop operation is disabled.
  → Holding the clear status may cause the servo clamp to stop functioning and the linear servomotor to move slowly due to drift in the speed loop.

When the clear signal (CLR) is not wired, the signal is always at low level (does not clear) and the position error pulses will not be cleared.

(4) Clear Operation Selection

This parameter determines when the error pulse should be cleared according to the condition of the SERVOPACK, in addition to the clearing operation of the clear signal (/CLR). Either of three clearing modes can be selected with Pn200.2

Parameter		Description
Pn200	n.☐**0**☐☐	Clear the error pulse during the baseblock. (Factory setting) "During the baseblock" means when the SVON signal or the main circuit power supply is OFF, or an alarm occurs.
	n.☐**1**☐☐	Do not clear the error pulse. Clear only with the /CLR signal.
	n.☐**2**☐☐	Clear the error pulse when an alarm occurs.

4.8.2 Setting the Electronic Gear

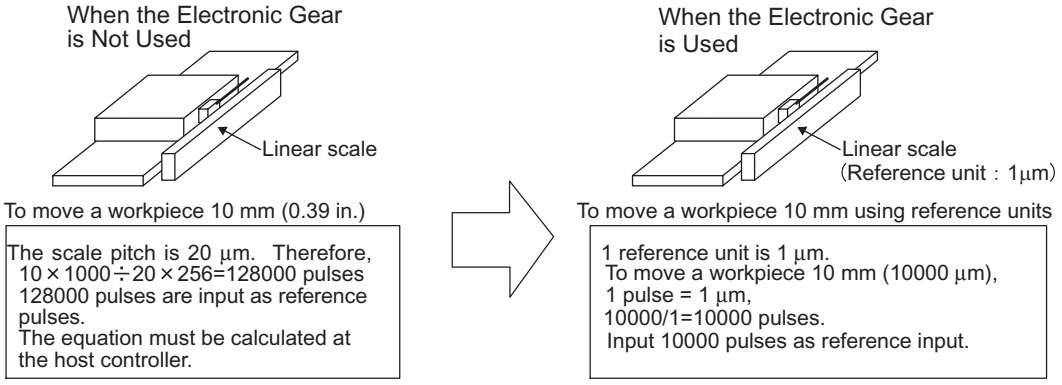
(1) Scale Feedback Resolution

The scale feedback resolution from the SERVOPACK is 1/256 of the scale pitch (Pn280).

Scale Pitch	Pulse Resolution
40 μm	0.156 μm
20 μm	0.078 μm
4 μm	0.016 μm

(2) Electronic Gear

The electronic gear enables the workpiece travel distance per input reference pulse from the host controller to be set to any value. One reference pulse from the host controller, i.e., the minimum position data unit, is called a reference unit.


When the Electronic Gear is Not Used
Linear scale
To move a workpiece 10 mm (0.39 in.)
The scale pitch is 20 μm. Therefore, 10 × 1000 ÷ 20 × 256=128000 pulses 128000 pulses are input as reference pulses.
The equation must be calculated at the host controller.
When the Electronic Gear is Used
Linear scale
(Reference unit : 1μm)
To move a workpiece 10 mm using reference units
1 reference unit is 1 μm.
To move a workpiece 10 mm (10000 μm),
1 pulse = 1 μm,
10000/1=10000 pulses.
Input 10000 pulses as reference input.

(3) Related Parameters

Pn202	Electronic Gear Ratio (Numerator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 65535	–	4	After restart

Pn203	Electronic Gear Ratio (Denominator)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 65535	–	1	After restart

The electronic gear ratio to be set can be calculated by the following equation:

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{Pn202}{Pn203} = \frac{\text{Workpiece travel distance per reference u}}{\text{Scale pitch}}$$

* If the ratio is outside the setting range, reduce the fraction (both numerator and denominator) until you obtain integers within the range. Be careful not to change the electronic gear ratio (B/A).

■ IMPORTANT

Electronic gear ratio setting range: $0.01 \leq$ Electronic gear ratio (B/A) ≤ 100

If the electronic gear ratio is outside this range, the SERVOPACK will not operate properly. In this case, modify the load configuration or reference unit.

(4) Procedure for Setting the Electronic Gear Ratio

Use the following procedure to set the electronic gear ratio.

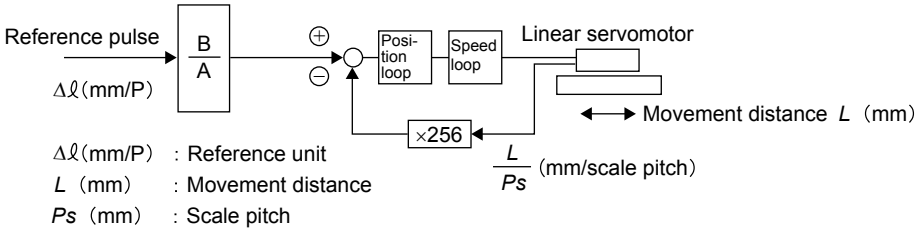
Step	Operation	Description
1	Check the scale pitch.	Check the scale pitch of linear scale used.
2	Determine the reference unit used.	Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
3	Calculate the electronic gear ratio.	Use the electronic gear ratio equation to calculate the ratio (B/A).
4	Set parameters.	Set parameters using the calculated values.

(5) Electronic Gear Ratio Setting Example

An example of electronic gear ratio setting is given below.

Step	Operation	Load Configuration	
1	Check the scale pitch.	0.02 mm (20 μm)	
2	Determine the reference unit.	1 reference unit: 0.001 mm (1 μm)	
3	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{1(\mu m)}{20(\mu m)} \times 256$	
4	Set parameters.	Pn202	256
		Pn203	20

(6) Electronic Gear Ratio Equation



Δℓ(mm/P) : Reference unit
L (mm) : Movement distance
Ps (mm) : Scale pitch

$$\frac{L}{\Delta \ell} \times \left(\frac{B}{A}\right) = 256 \times \frac{L}{Ps}$$

$$\left(\frac{B}{A}\right) = \frac{256 \times L \times \Delta \ell}{Ps \times L} = \frac{256 \times \Delta \ell}{Ps}$$

Set A and B with the following parameters.

A : Pn203 B : Pn202

4.8.3 Position Reference

The servomotor positioning is controlled by inputting a pulse train reference.

The pulse train output form from the host controller corresponds to the following:

- Line-driver Output
- +24V Open-collector output
- +12V Open-collector output
- +5V Open-collector output

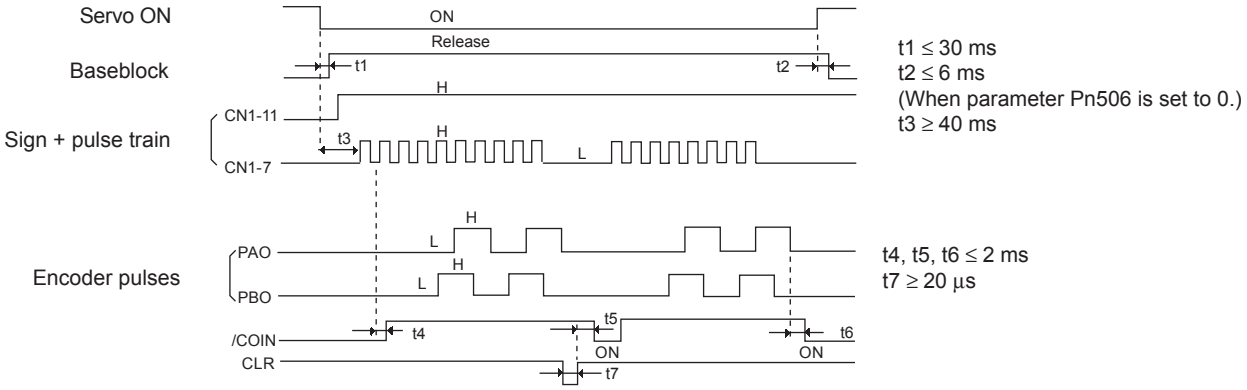
IMPORTANT

■Precautions for Open-collector Output

When the open-collector output is used, input signal noise margin lowers. Change the parameter as follows:

Parameter		Description
Pn200	n.**1**□□□	Reference input filter for open-collector signal

(1) Input/Output Signal Timing Example



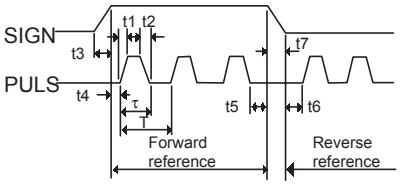
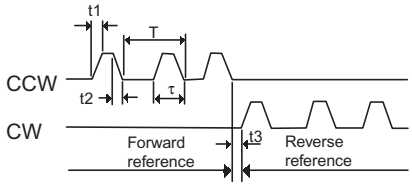
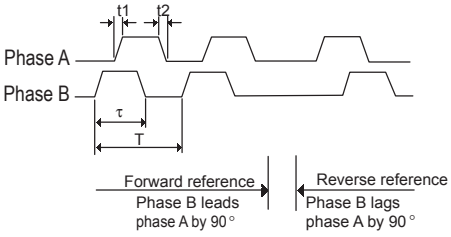
Note: 1. The interval from the time the servo ON signal is turned ON until a reference pulse is input must be at least 40 ms, otherwise the reference pulse may not be received by the SERVOPACK.

2. The error counter clear signal must be ON for at least 20 μs.

(2) Reference Pulse Input Signal Timing

The reference pulse input signal timing is shown below.

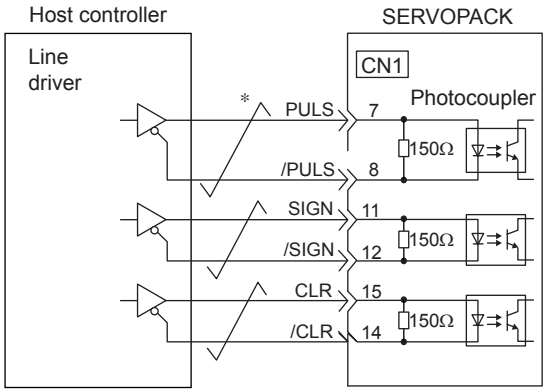
Table 4.1 Reference Pulse Input Signal Timing

Reference Pulse Signal Form	Electrical Specifications		Remarks
Sign and pulse train input (SIGN and PULS signal) Maximum reference frequency: 500 kpps (For open-collector output: 200 kpps)		t1, t2 ≤ 0.1 ms t3, t7 ≤ 0.1 ms t4, t5, t6 > 3 μs τ ≥ 1.0 μs (τ/T) × 100 ≤ 50%	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse and CCW pulse Maximum reference frequency: 500 kpps (For open-collector output: 200 kpps)		t1, t2 ≤ 0.1 ms t3 > 3 μs τ ≥ 1.0 μs (τ/T) × 100 ≤ 50%	–
Two-phase pulse train with 90° phase differential (phase A and phase B) Maximum reference frequency ×1 input pulse multiplier: 500 kpps ×2 input pulse multiplier: 400 kpps ×4 input pulse multiplier: 200 kpps		t1, t2 ≤ 0.1 ms τ ≥ 1.0 μs (τ/T) × 100 = 50%	Switching of the input pulse multiplier mode is done with parameter Pn200.0 setting.

(3) Connection Example

(a) Connection Example for Line-driver Output

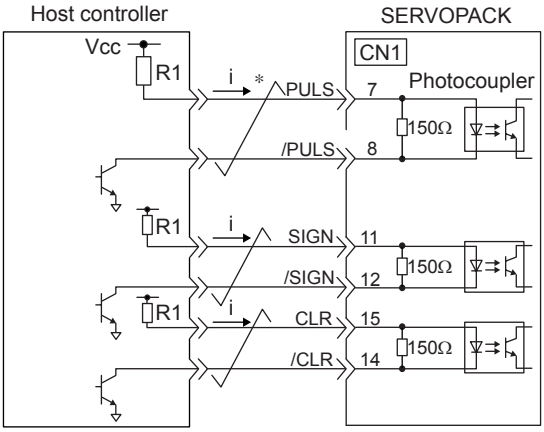
Applicable line driver: SN75174 manufactured by Texas Instruments Inc., or MC3487 or equivalent



* : Represents twisted-pair wires.

(b) Connection Example for Open-collector Output

Select the limit resistance R1 value so that the input current *i* will be within 7 to 15 mA.



■Example

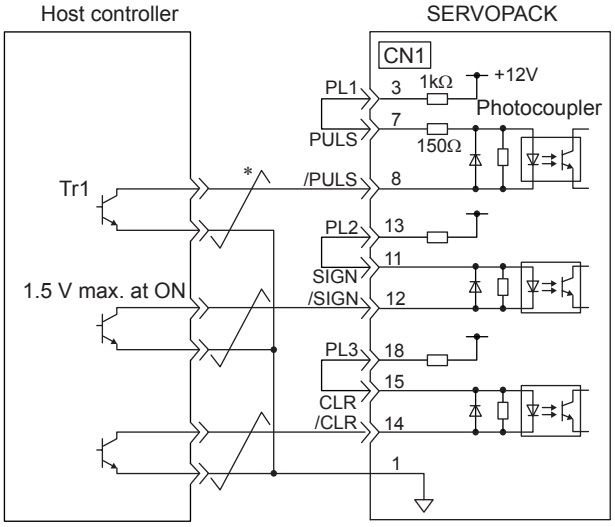
- When Vcc is +24V: R1=2.2 kΩ
- When Vcc is +12V: R1=1 kΩ
- When Vcc is +5V: R1=180 Ω

Note: When the open-collector output is used, the signal logic is as follows:

When Tr1 is ON	High level input or equivalent
When Tr1 is OFF	Low level input or equivalent

* : Represents twisted-pair wires.

When the external power supply is used, the circuit will be isolated by a photocoupler. When the SERVOPACK internal power supply is used, the circuit will not be isolated.



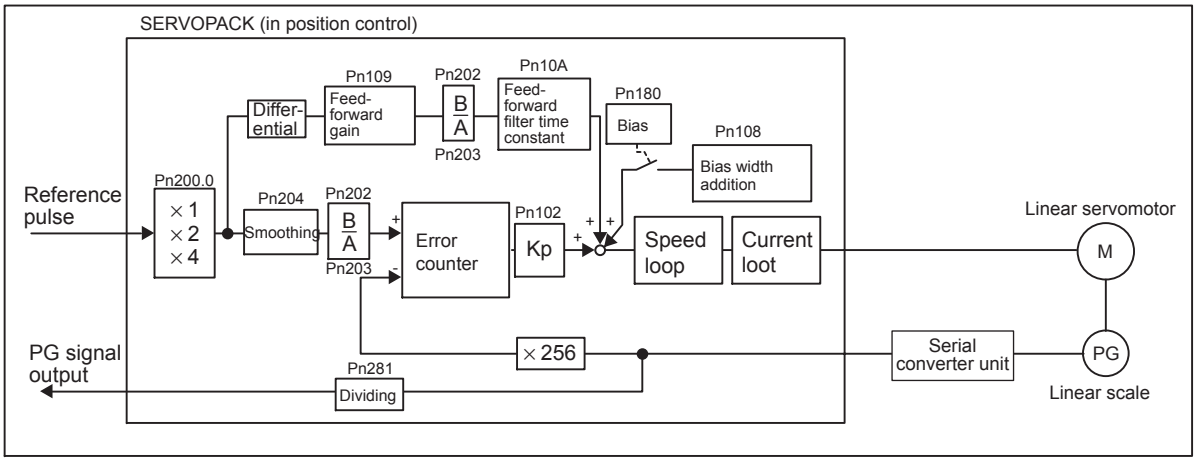
* : Represents twisted-pair wires.

IMPORTANT

When the open-collector output is used, input signal noise margin lowers. Set the parameter Pn200.3 to 1.

(4) Position Control Block Diagram

A block diagram for position control is shown below.



4.8.4 Smoothing

A filter can be applied in the SERVOPACK to a constant-frequency reference pulse.

(1) Selecting a Position Reference Filter

Parameter		Description
Pn207	n.□□□**0**	Acceleration/deceleration filter
	n.□□□**1**	Average movement filter

* After resetting the parameter, turn OFF the power once and turn it ON again.

(2) Filter-related Parameters

Pn204 Position Reference Acceleration/Deceleration Time Constant [Position]

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 6400	0.01 ms	0	Immediately

Pn208 Average Movement Time of Position Reference [Position]

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 6400	0.01 ms	0	Immediately

■ IMPORTANT

When the position reference acceleration/deceleration time constant (Pn204) is changed, a value with no reference pulse input and a position error of 0 will be enabled. To ensure that the setting value is correctly reflected, stop the reference pulse from the host controller and input the clear signal (/CLR), or turn the servo OFF to clear the error.

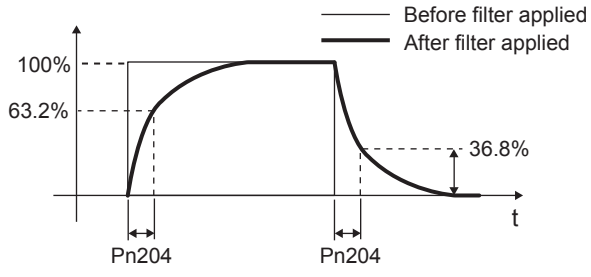
This function provides smooth motor operating in the following cases. The function does not affect the travel distance (i.e., the number of pulses).

- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10× or more).

The difference between the position reference acceleration/deceleration time constant (Pn204) and the position reference movement averaging time (Pn208) is shown below.

Acceleration/Deceleration Filter

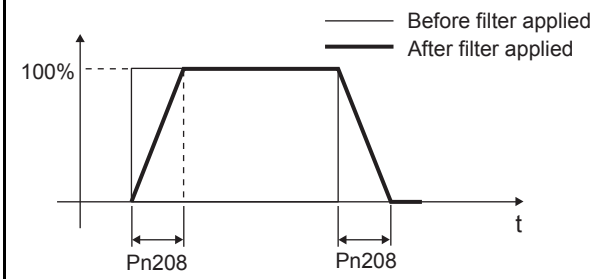
Pn207=n.□□□0



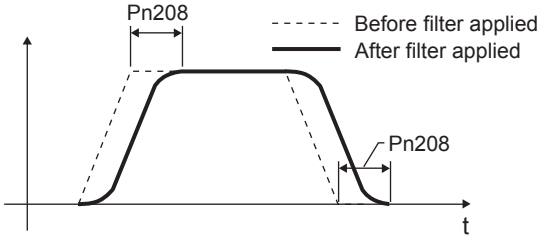
Response waveform for stepwise input

Average Movement Time Filter

Pn207=n.□□□1



Response waveform for stepwise input



Response waveform for ramp reference input

4.8.5 Positioning Completed Output Signal

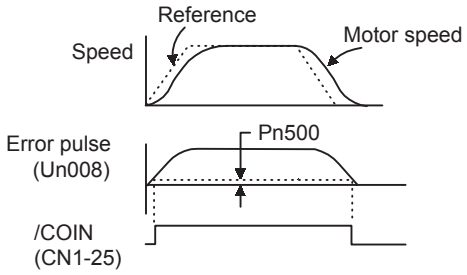
This signal indicates that servomotor movement has been completed during position control. Use the signal as an interlock to confirm at the host controller that positioning has been completed.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/COIN	CN1-25, 26 (Factory setting)	ON (low level)	Positioning has been completed.
			OFF (high level)	Positioning is not completed.
This output signal can be allocated to an output terminal with parameter Pn50E. The factory setting is allocated to CN1-25, 26.				

Pn500 Positioning Completed Width — Position

Setting Range	Setting Unit	Factory Setting	Setting Validation
0 to 250	Reference units	7	Immediately

The positioning completed (/COIN) signal is output when the difference (position error pulse) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter.



Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)

Too large a value at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.

If a servo gain is set that keeps the position error small even when the positioning completed width is large, use Pn207 = n.1□□□ to enable correct output timing for the COIN signal.

The positioning completed width setting has no effect on final positioning accuracy.

/COIN is a position control signal.

When the factory setting is used and the output terminal allocation is not performed with the Pn50E, this signal is used for the speed coincidence output /V-CMP for speed control, and it is always OFF (high level) for force control.

4.8.6 Positioning Near Signal

This signal indicates that the positioning of the linear servomotor is near to completion, and is generally used in combination with the positioning completed (/COIN) output signal.

The host controller receives the positioning near signal prior to confirming the positioning-completed signal, and performs the following operating sequence after positioning has been completed to shorten the time required for operation.

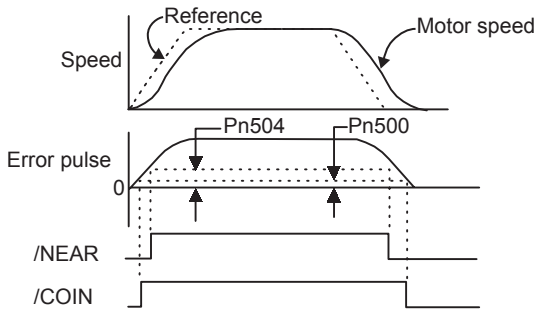
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (low level)	The servomotor has reached a point near to positioning completed.
			OFF (high level)	The servomotor has not reached a point near to positioning completed.
The output terminal must be allocated with parameter Pn510 in order to use positioning near signal. Refer to *3.3.3 Output Circuit Signal Allocation* for details.				

Pn504	NEAR Signal Width			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 250	Reference units	7	Immediately

The positioning near (/NEAR) signal is output when the difference (error) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in Pn504.

Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)

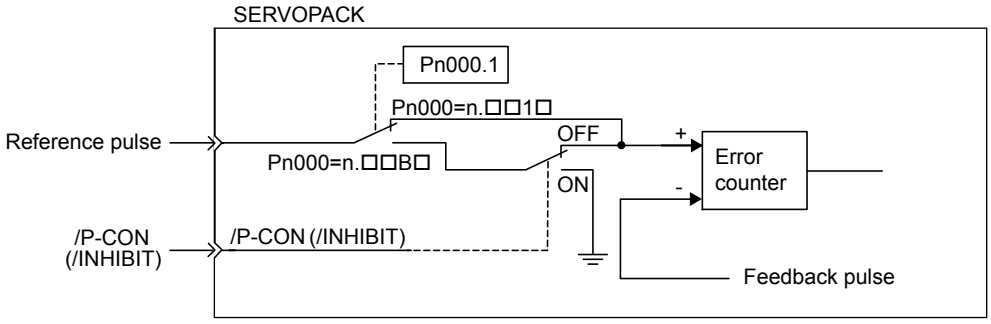
Normally, the setting should be larger than that for the positioning completed width (Pn500).



4.8.7 Reference Pulse Inhibit Function (INHIBIT)

(1) Description

This function inhibits the SERVOPACK from counting input pulses during position control. The servomotor remains locked (clamped) while pulse are inhibited.

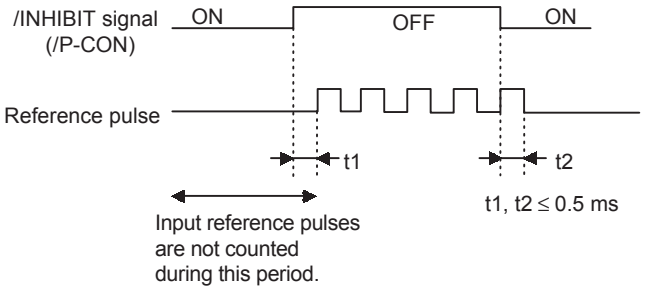


(2) Setting Parameters

Parameter		Meaning
Pn000	n.□□**B**□	Control mode selection: Position control (pulse train reference) ⇔ Inhibit

■ Inhibit (INHIBIT) switching condition

・/P-CON (/INHIBIT) signal ON (low level)



(3) Setting Input Signals

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 (Factory setting)	ON (low level)	Turns the INHIBIT function ON. (Inhibits the SERVOPACK from counting reference pulses.)
			OFF (high level)	Turns the INHIBIT function OFF. (Counts reference pulses.)
(Input)	(/INHIBIT)	Must be allocated CN1-□□	ON (low level)	Turns the INHIBIT function ON. (Inhibits the SERVOPACK from counting reference pulses.)
			OFF (high level)	Turns the INHIBIT function OFF. (Counts reference pulses.)
These input signals enable the inhibit function. Either the /P-CON or the /INHIBIT signal can be used to switch the inhibit signal. The input signal must be allocated in order to use the /INHIBIT signal. Refer to *3.3.2 Input Circuit Signal Allocation*.				

4.9 Operating Using Force Control

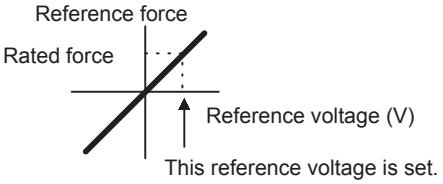
4.9.1 Setting Parameters

The following parameters must be set for force control operation with analog voltage reference.

Parameter		Meaning
Pn000	n.□□2□	Control mode selection: Force control (analog voltage reference)

Pn400	Force Reference Input Gain		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	10 to 100 (1.0 to 10.0 V/rated force)	0.1V/rated force	30	Immediately	

This sets the analog voltage level for the force reference (T-REF) that is necessary to operate the linear servomotor at the rated force.



■ EXAMPLE

Pn400 = 30: The linear servomotor operates at the rated force with 3-V input (factory setting).

Pn400 = 1000: The linear servomotor operates at the rated force with 10-V input.

Pn400 = 200: The linear servomotor operates at the rated force with 2-V input.

4.9.2 Force Reference Input

By applying a force reference determined by the analog voltage reference to the SERVOPACK, the linear servomotor force can be controlled in proportion with the input voltage.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force Reference Input
	SG	CN1-10	Signal Ground for Force Reference Input

Used during force control (analog voltage reference). (Pn000.1 = 2, 6, 8, 9)

The force reference gain is set in Pn400. For setting details, refer to *4.9.1 Setting Parameters*.

■ Input Specifications

- Input range: ±1 to ±10 VDC/rated force
- Max. allowable input voltage: ±12 VDC
- Factory setting

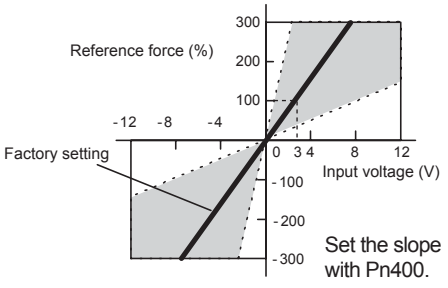
Pn400 = 30: Rated force at 3 V

+3-V input: Rated force in forward direction

+9-V input: 300% rated force in forward direction

-0.3-V input: 10% rated force in reverse direction

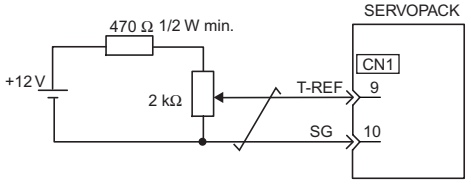
The voltage input range can be changed with parameter Pn400.



■ Input Circuit Example

Use twisted-pair wires as a countermeasure against noise.

Variable resistor example: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.



INFO

■ Checking the Internal Force Reference

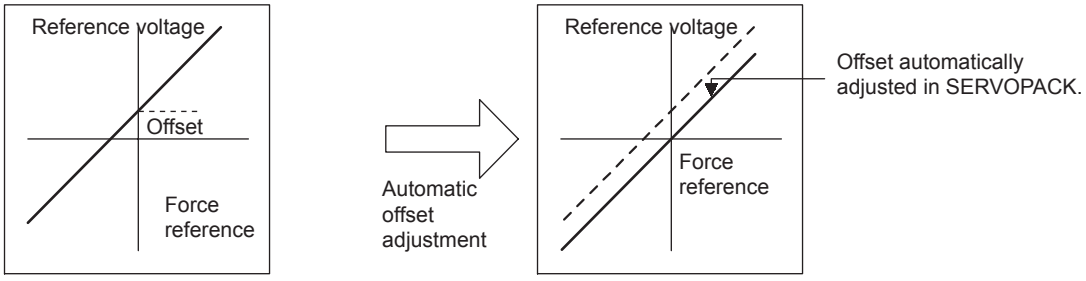
1. Checking the internal force reference with the panel operator:
   Use the Monitor Mode (Un-002). Refer to *3.4 Operation in Monitor Mode (Un□□□)*.
2. Checking the internal force reference with an analog monitor:
   The internal force reference can also be checked with an analog monitor. Refer to *5.5 Analog Monitor*.

4.9.3 Adjusting the Force Reference Offset

When using force control, the linear servomotor may move slowly even when 0 V is specified as the analog reference voltage. This occurs when the host controller or external circuit has a slight offset (measured in mV) in the reference voltage. In this case, the reference offset can be adjusted automatically and manually using the panel operator or digital operator.

The automatic adjustment of analog (speed, force) reference offset (Fn009) automatically measures the offset and adjusts the reference voltage.

The SERVOPACK performs the following automatic adjustment when the host controller or external circuit has an offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK. The amount of offset can be checked in the manual adjustment of force reference offset (Fn00B).

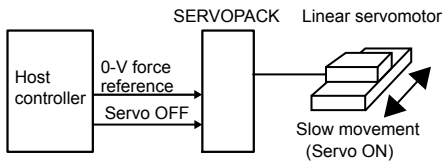
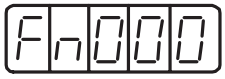
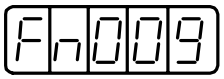
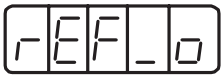
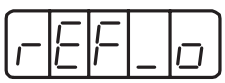
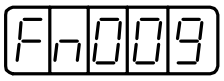
(1) Automatic Adjustment of the Force Reference Offset

The automatic adjustment of analog reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. Use the force reference offset manual adjustment (Fn00B).

IMPORTANT

The analog reference offset must be automatically adjusted with the servo OFF.

Use the following procedure for automatic adjustment of the force reference offset.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1				Turn OFF the SERVOPACK, and input the 0-V reference voltage from the host controller or external circuit.
2		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
3				Press the LEFT/RIGHT or UP/DOWN Key, or UP or DOWN Key to select parameter Fn009. *The digit that can be set will blink.
4		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. “rEF_o” will be displayed.
5		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The reference offset will be automatically adjusted. When completed, “donE” will blink for about one second.
6		About one second later		After “donE” is displayed, “rEF_o” will be displayed again.
7		(DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn009 display of the utility function mode.

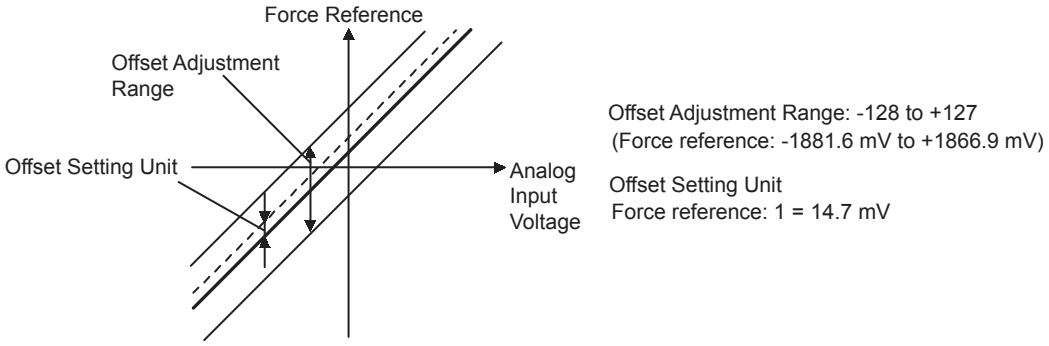
(2) Manual Adjustment of the Force Reference Offset

Manual adjustment of the force reference offset (Fn00B) is used in the following cases.

- If a position loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- Use this mode to check the offset data that was set in the automatic adjustment mode of the force reference offset.

This mode operates in the same way as the automatic adjustment mode (Fn009), except that the amount of offset is directly input during the adjustment.

The offset adjustment range and setting units are as follows:


Force Reference
Offset Adjustment Range
Offset Setting Unit
Analog Input Voltage
Offset Adjustment Range: -128 to +127
(Force reference: -1881.6 mV to +1866.9 mV)
Offset Setting Unit
Force reference: 1 = 14.7 mV

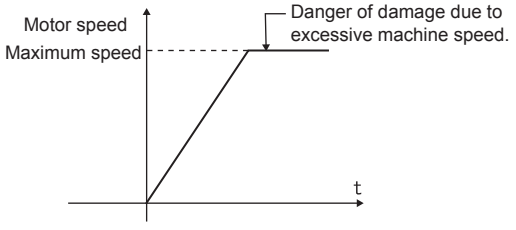
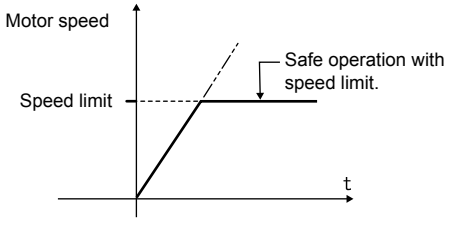
Use the following procedure to manually adjust the force reference offset.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn00b			Press the LEFT/RIGHT or UP/DOWN Key or UP or DOWN Key to select parameter Fn00B. *The digit that can be set will blink.
3	-.tr9	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second. The display will be as shown at the left. The manual adjustment mode for the force reference offset will be entered.
4	-.tr9	Servo ON		Turn ON the servo ON (/S-ON) signal. The display will be as shown at the left.
5	-0000		DATA/◀ (DATA/SHIFT Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to display the force reference offset amount.
6				Press the UP or DOWN Key to adjust the amount of offset.
7	-.tr9		DATA/◀ (DATA/SHIFT Key) (Less than 1 s.)	Press the LEFT or RIGHT Key or DATA/SHIFT Key for less than one second to return to the display shown on the left.
8	Fn00b	DATA ENTER (DATA/ENTER Key)	DATA◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER Key once, or DATA/SHIFT Key for more than one second to return to the Fn00B display of the utility function mode.

4.9.4 Limiting Linear Servomotor Speed during Force Control

During force control, the linear servomotor is controlled to output the specified force, which means that the linear servomotor speed is not controlled. Accordingly, when an excessive reference force is set for the mechanical load force, it will prevail over the mechanical load force and the linear servomotor speed will greatly increase.

This function serves to limit the linear servomotor speed during force control to protect the machine.

With No Speed Limit	With Speed Limit
	

(1) Speed Limit Mode Selection (Force Limit Option)

Parameter		Description
Pn002	n.☐☐**0**☐	Uses the value set in Pn480 as the speed limit (internal speed limit function).
	n.☐☐**1**☐	Uses V-REF (CN1-5, 6) as an external speed limit input. Applies a speed limit using the input voltage of V-REF and the setting in Pn300 (external speed limit function).

(2) Internal Speed Limit Function

Pn480	Speed Limit During Force Control			Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	5000	Immediately

Sets the linear servomotor speed limit value during force control.
The setting in this parameter is enabled when Pn002 = n.□□0□.
The servomotor's maximum speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.

(3) External Speed Limit Function

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	External Speed Limit Input
	SG	CN1-6	Signal Ground

Inputs an analog voltage reference as the linear servomotor speed limit value during force control.
The smaller value is enabled, the speed limit input from V-REF or the Pn480 (Speed Limit during Force Control) when Pn002 = n.□□1□.
The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.

Pn300	Speed Reference Input Gain			Speed Position Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	150 to 3000 (1.50 to 30.0 V/rated speed)	0.01 V/rated speed	600 (6.00 V/rated speed)	Immediately

Sets the voltage level for the speed that is to be externally limited during force control.
With Pn300 = 600 (factory setting) and 6 V input from V-REF (CN1-5, 6), the actual motor speed is limited to the rated speed of the servomotor used.

INFO

■ The Principle of Speed Limiting

When the speed is outside of the allowable range, a force that is proportional to the difference between the actual speed and the speed limit is used as negative feedback to bring the speed back within the speed limit range. Accordingly, there is a margin generated by the load conditions in the actual motor speed limit value.

(4) Signals Output during Servomotor Speed Limit

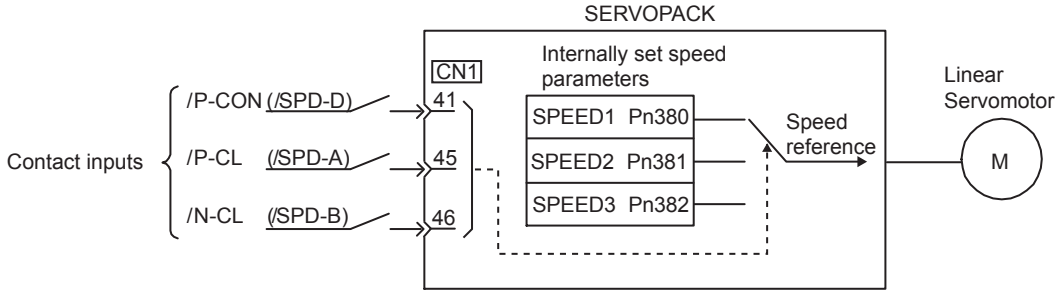
Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/VLT	Must be allocated CN1-□□	ON (low level)	Servomotor speed limit being applied.
			OFF (high level)	Servomotor speed limit not being applied.

This signal is output when the linear servomotor speed reaches the speed limit value set in Pn480 or set by the analog voltage reference.
For use, this output signal must be allocated with parameter Pn50F. For details, refer to *3.3.3 Output Circuit Signal Allocation*.

4.10 Operating Using Speed Control with an Internally Set Speed

- Internally Set Speed Selection

This function allows speed control operation by externally selecting an input signal from among three servomotor speed settings made in advance with parameters in the SERVOPACK. The speed control operations within the three settings are valid. There is no need for an external speed or pulse generator.



4.10.1 Setting Parameters

Parameter		Meaning
Pn000	n.☐☐**3**☐	Control mode selection: Internally set speed control (contact reference)

Pn380	Internally set speed 1 (SPEED1)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	10	Immediately
Pn381	Internally set speed 2 (SPEED2)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	20	Immediately
Pn382	Internally set speed 3 (SPEED3)		Speed	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 5000	1 mm/s	30	Immediately

Note: The maximum speed of linear servomotor is used whenever a speed settings for the Pn380 to Pn382 exceed the maximum speed.

4.10.2 Input Signal Settings

The following input signals are used to switch the operating speed.

Type	Signal Name	Connector Pin Number	Meaning
Input	/P-CON	CN1-41	Switches the linear servomotor movement direction.
	(/SPD-D)	Must be allocated	
Input	/P-CL	CN1-45	Selects the internally set speed.
	(/SPD-A)	Must be allocated	
Input	/N-CL	CN1-46	Selects the internally set speed.
	(/SPD-B)	Must be allocated	

■ Input Signal Selection

The following two types of operation can be performed using the internally set speeds:

• Operation with the /P-CON, /P-CL, and /N-CL input signals (pins allocated in factory setting)

• Operation with the /SPD-D, /SPD-A, and /SPD-B input signals

/SPD-D, /SPD-A, and /SPD-B input signals must be allocated with parameter Pn50C. Refer to *3.3.2 Input Circuit Signal Allocation*.

4.10.3 Operating Using an Internally Set Speed

Use ON/OFF combinations of the following input signals to operate with the internally set speeds.

Input Signal			Motor Movement Direction	Speed
/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)		
OFF (high)	OFF (high)	OFF (high)	Forward	Stop at 0 of the internally set speed
	OFF (high)	ON (low)		Pn380: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn381: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn382: Internally Set Speed 3 (SPEED3)
ON (low)	OFF (high)	OFF (high)	Reverse	Stop at 0 of the internally set speed
	OFF (high)	ON (low)		Pn380: Internally Set Speed 1 (SPEED1)
	ON (low)	ON (low)		Pn381: Internally Set Speed 2 (SPEED2)
	ON (low)	OFF (high)		Pn382: Internally Set Speed 3 (SPEED3)

Note: Signal OFF = High level; Signal ON = Low level

IMPORTANT

■Control Mode Switching

When Pn000.1 = 4, 5, or 6, and either /P-CL (/SPD-A) or /N-CL (SPD-B) is OFF (high level), the control mode will switch.

Example:

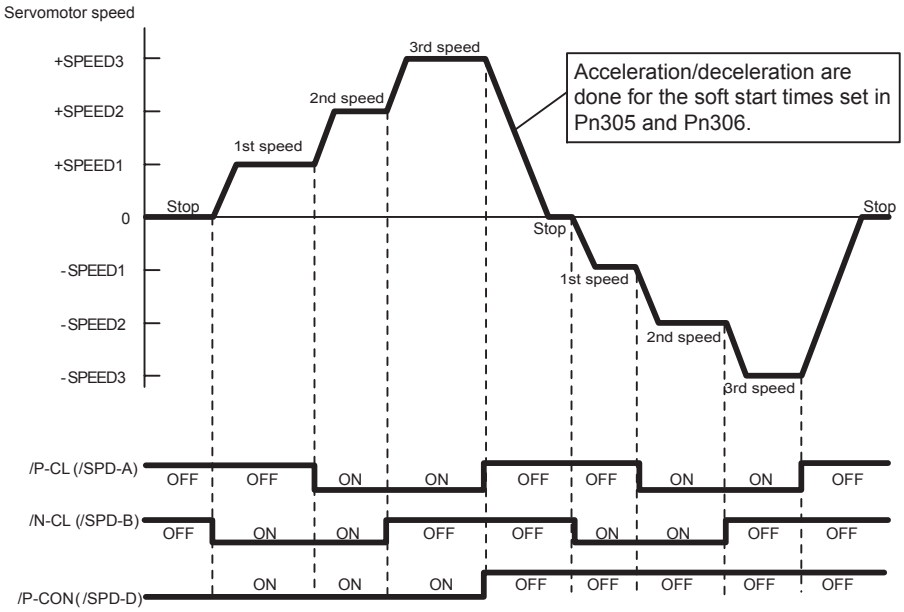
When Pn000.1=5: Internally set speed selection ⇔ Position control (pulse train)

Input Signal		Speed
/P-CL (/SPD-A)	/N-CL (/SPD-B)	
OFF (high)	OFF (high)	Pulse train reference input (position control)
OFF (high)	ON (low)	Pn380: Internally Set Speed 1 (SPEED1)
ON (low)	ON (low)	Pn381: Internally Set Speed 2 (SPEED2)
ON (low)	OFF (high)	Pn382: Internally Set Speed 3 (SPEED3)

- Example of Operating with Internally Set Speed Selection

The shock that results when the speed is changed can be reduced by using the soft start function.
For details on the soft start function, refer to *4.7.4 Soft Start*.

Example: Operation with an Internally Set Speed and Soft Start

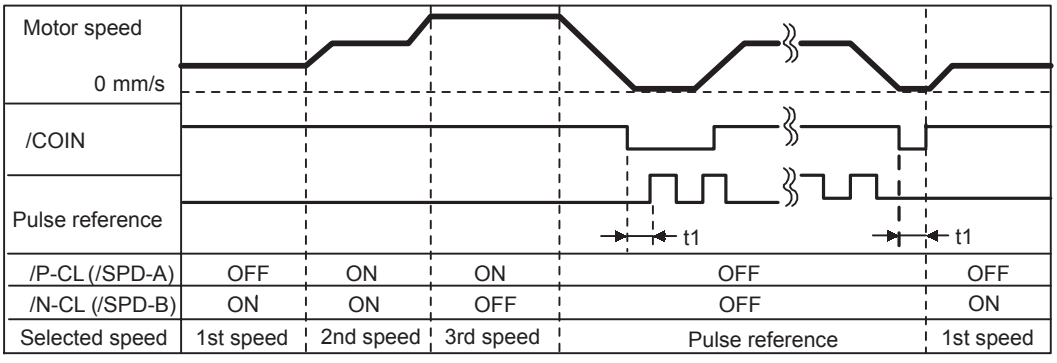


IMPORTANT

When Pn000.1 = 5 (Internally set speed control ⇔ Position control), the soft start function will operate only when selecting the internally set speed. The soft start function cannot be used with pulse reference input. When switching to pulse reference input during operation at either of the three speeds (1st speed to 3rd speed), the pulse reference will not be received by the SERVOPACK until after the positioning completed (/COIN) signal is output. Always begin the output of the pulse reference from the host controller after the positioning completed (/COIN) signal is output from the SERVOPACK.

Example: Operation with an Internally Set Speed and Soft Start ⇔ Position Control (Pulse Train Reference)

Signal Timing in Position Control



Note: 1. The soft start function is used in the above figure.
2. The t_1 value is not affected by whether the soft start function is used.
A maximum delay of 2 ms occurs in loading /P-CL (/SPD-A) and /N-CL (/SPD-B).

4.11 Limiting Force

The SERVOPACK provides the following four methods for limiting output force to protect the machine.

Setting Level	Limiting Method	Reference Section
1	Internal force limit	4.11.1
2	External force limit	4.11.2
3	Force limiting by analog voltage reference	4.11.3
4	External force limit + Force limiting by analog voltage reference	4.11.4

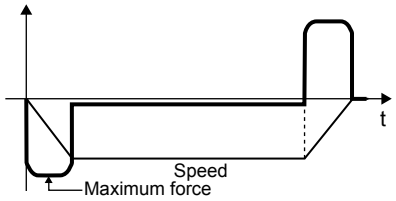
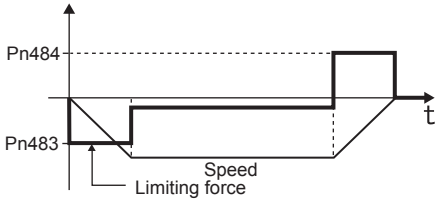
4.11.1 Internal Force Limit (Limiting Maximum Output Force)

Maximum force is always limited to the values set in the following parameters.

Pn483	Forward Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800	%	30	Immediately	
Pn484	Reverse Force Limit		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 800	%	30	Immediately	

The settings in these parameters are constantly enabled. The setting unit is a percentage of rated force.

If the force limit is set higher than the maximum force of the linear servomotor, the maximum force of the linear servomotor is used.

No Internal Force Limit (Maximum force can be output.)	Internal Force Limit
	

Too small a force limit setting will result in insufficient force during acceleration and deceleration.

IMPORTANT

For safe operation at setup of linear servomotor, the factory setting of Pn483 and Pn484 are 30%, which are relatively low. After having set up the linear servomotor, increase the settings of Pn483 and Pn484 to the desired level. (Set to 800% if there is no restriction.)

4.11.2 External Force Limit (Output Force Limiting by Input Signals)

This function allows the force to be limited at specific times during machine operation, for example, during press stops and hold operations for robot workpieces.

An input signal is used to enable the force limits previously set in parameters.

(1) Related Parameters

Pn404	Forward External Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately
Pn405	Reverse External Force Limit		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately

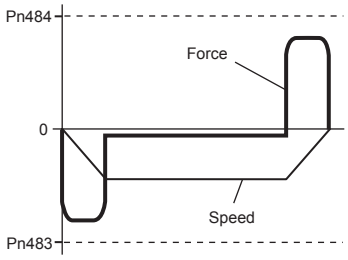
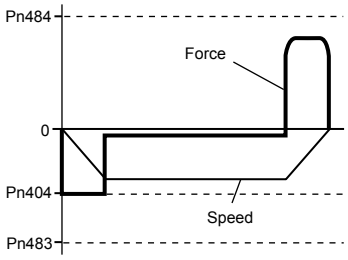
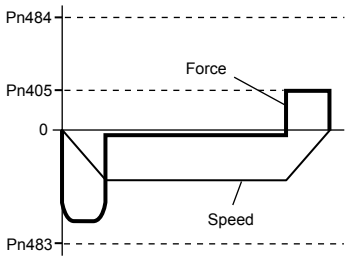
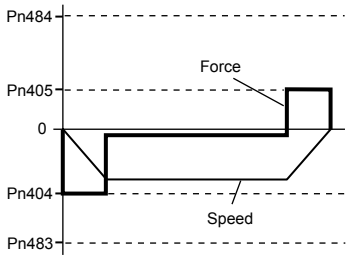
Note: The setting unit is a percentage of rated force (i.e., the rated force is 100%).

(2) Input Signals

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory Setting)	ON (low level)	Forward external force limit ON	The value set in Pn483 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 (Factory Setting)	ON (low level)	Reverse external force limit ON	The value set in Pn484 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external force limit OFF	Pn484
When using this function, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to *3.3.2 Input Circuit Signal Allocation*.					

(3) Changes in Output Force during External Force Limit

Example: External force limit (Pn483, Pn484) set to 800%

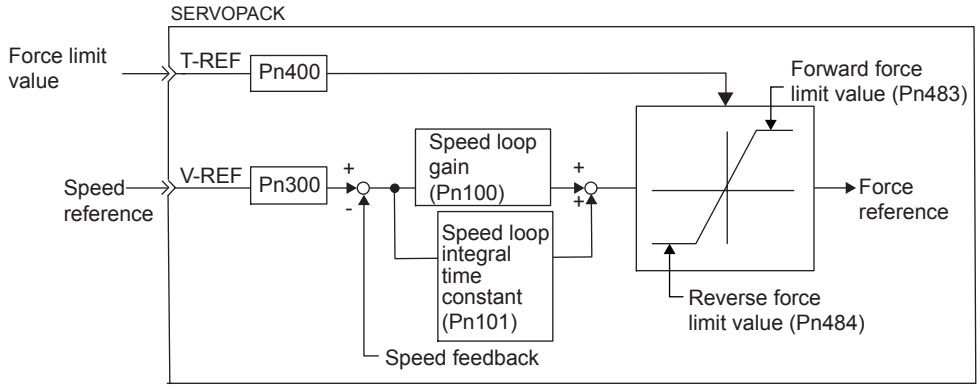
<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">/P-CL (Forward External Force Limit Input)</td></tr>
<tr><td>High level</td><td>Low level</td></tr>
<tr><td rowspan="2">/N-CL (Reverse External Force Limit Input)</td><td>High level</td><td> 
</td><td> 
</td></tr>
<tr><td>Low level</td><td> 
</td><td> 
</td></tr>
</table>

Note: In this example, the linear servomotor movement direction is Pn000 = n.□□□0 (standard setting, CCW = forward).

4.11.3 Force Limiting Using an Analog Voltage Reference

Force limiting by analog voltage reference limits force by assigning a force limit in an analog voltage to the T-REF terminals (CN1-9 and 10). This function can be used only during speed or position control, not during force control.

Refer to the following block diagram when the force limit with an analog voltage reference is used for speed control.



INFO

There is no polarity in the input voltage of the analog voltage reference for force limiting. The absolute values of both + and - voltages are input, and a force limit value corresponding to that absolute value is applied in the forward or reverse direction.

(1) Related Parameters

Parameter		Meaning
Pn002	n.□□□**1**	Speed control option: Uses the T-REF terminal to be used as an external force limit input.
When n.□□□2 is set, the T-REF terminal is used for force feed-forward input, but the functions cannot be used together.		

(2) Input Signals

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force reference input
	SG	CN1-10	Signal ground for force reference input

The force limit input gain is set at parameter Pn400. Refer to *4.9.1 Setting Parameters*.

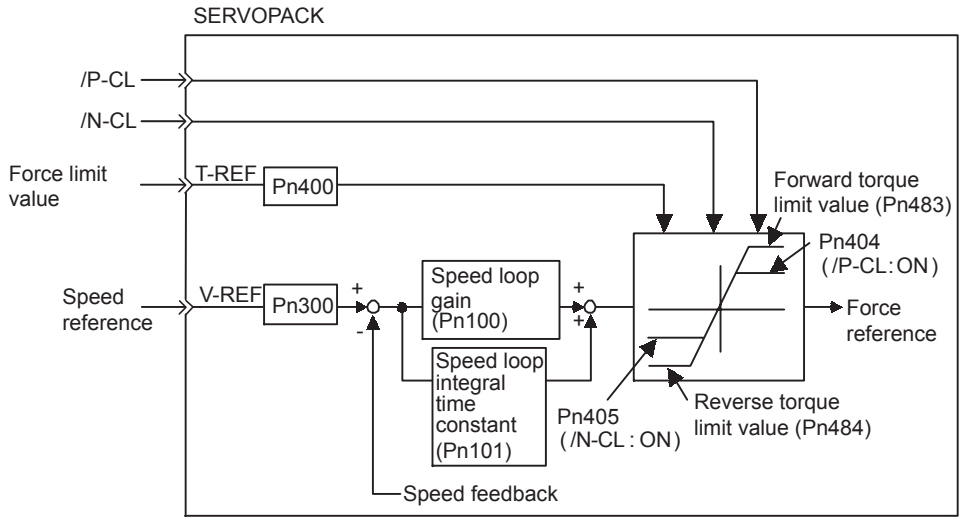
■ Input Specifications

- Input range: ±1 VDC to ±10 VDC/rated force
- Maximum allowable input voltage: ±12 VDC

4.11.4 Force Limiting Using an External Force Limit and Analog Voltage Reference

This function can be used to combine force limiting by an external input signal and by analog voltage reference. Because the force limit by analog voltage reference is input from T-REF (CN1-9, 10), this function cannot be used during force control. Use /P-CL (CN1-45) or /N-CL (CN1-46) for force limiting by external input signal.

When /P-CL (or /N-CL) is ON, either the force limit by analog voltage reference or the setting in Pn404 (or Pn405) will be applied as the force limit, whichever is smaller.



(1) Related Parameters

Parameter		Meaning
Pn002	n.□□□**3**	Speed control option: When /P-CL or /N-CL is enabled, the T-REF terminal is used as the external torque limit input.
When n.□□□2 is set, T-REF is used for force feed-forward input, but the functions cannot be used together.		

Pn404	Forward External Force Limit			Speed Position Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately
Pn405	Reverse External Force Limit			
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 800	%	100	Immediately

* The setting unit is a percentage of rated force (i.e., the rated force is 100%).

(2) Input Signals

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force reference input
	SG	CN1-10	Signal ground for force reference input

The force limit input gain is set in parameter Pn400. Refer to *4.9.1 Setting Parameters*.

■ Input Specifications

- Input range: ±1 VDC to ±10 VDC/rated force
- Maximum allowable input voltage: ±12 VDC

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 (Factory setting)	ON (low level)	Forward external force limit ON	The analog voltage reference limit or the value set in Pn483 or Pn404 (whichever is smaller)
			OFF (high level)	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 (Factory setting)	ON (low level)	Reverse external force limit ON	The analog voltage reference limit or the value set in Pn484 or Pn405 (whichever is smaller)
			OFF (high level)	Reverse external force limit OFF	Pn484

When using the force limiting with the external force limit and analog voltage reference, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to *3.3.2 Input Circuit Signal Allocation*.

4.11.5 Checking Output Force Limiting during Operation

The following signal can be output to indicate that the servomotor output force is being limited.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/CLT	Must be allocated	ON (low level)	Servomotor output force is being limited.
			OFF (high level)	Force is not being limited.

The output terminal must be allocated with parameter Pn50F to use this output signal. Refer to *3.3.3 Output Circuit Signal Allocation* for details.

4.12 Control Mode Selection

The methods and conditions for switching SERVOPACK control modes are described below.

4.12.1 Setting Parameters

The following combinations of control modes can be selected according to the application at hand.

Parameter		Control Method
Pn000	n.☐☐**4**☐	Internally set speed control (contact reference) ⇔ Speed control (analog voltage reference)
	n.☐☐**5**☐	Internally set speed control (contact reference) ⇔ Position control (pulse train reference)
	n.☐☐**6**☐	Internally set speed control (contact reference) ⇔ Force control (analog voltage reference)
	n.☐☐**7**☐	Position control (pulse train reference) ⇔ Speed control (analog voltage reference)
	n.☐☐**8**☐	Position control (pulse train reference) ⇔ Force control (analog voltage reference)
	n.☐☐**9**☐	Force control (analog voltage reference) ⇔ Speed control (analog voltage reference)
	n.☐☐**A**☐	Speed control (analog voltage reference) ⇔ Zero clamp
	n.☐☐**B**☐	Position control (pulse train reference) ⇔ Position control (inhibit)

4.12.2 Switching the Control Mode

(1) Switching Internally Set Speed Control (Pn000.1 = 4, 5, or 6)

With the sequence input signals in the factory setting (Pn50A = n.☐☐☐0), the control mode will switch when both /P-CL (/SPD-A) and /N-CL (/SPD-B) signals are OFF (high level).

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CL	CN1-45 (Factory setting)	OFF (high level)	Switches control mode.
	(/SPD-A)	Must be allocated		
Input	/N-CL	CN1-46 (Factory setting)	OFF (high level)	
	(/SPD-B)	Must be allocated		

■ Input Signal Selection

The following two types of control mode selection are available for switching from internally set speed control:

- Switching with the /P-CL and /N-CL input signals (pins allocated in factory setting)
- Switching with the /SPD-A and /SPD-B input signals

When using /SPD-A and /SPD-B, they must be allocated with parameter Pn50C. Refer to *3.3.2 Input Circuit Signal Allocation*.

(2) Switching Other Than Internally Set Speed Control (Pn000.1 = 7, 8, 9, A, or B)

Use the following signals to switch control modes. The control modes switch as shown below for each of the signal states indicated.

When changing the sequence input signal from the factory setting (Pn50A = n.□□□1), allocate the /C-SEL to an input terminal and change modes with the /C-SEL signal. In this case, input a speed reference (analog voltage reference) for speed control, and a position reference (pulse train reference) for position control.

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting				
				n.□□**7**□	n.□□**8**□	n.□□**9**□	n.□□**A**□	n.□□**B**□
Input	/P-CON	CN1-41 (Factory setting)	ON (low level)	Speed	Force	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Force	Speed	Position
(Input)	(/C-SEL)	Must be allocated	ON (low level)	Speed	Force	Speed	Zero clamp	Inhibit
			OFF (high level)	Position	Position	Force	Speed	Position
The control mode can be switched with either /P-CON or /C-SEL. When using the /C-SEL signal, the input signal must be allocated. Refer to *3.3.2 Input Circuit Signal Allocation*.								

4.13 Other Output Signals

The following output signals, which have no direct connection with the control modes, are used for machine protection.

4.13.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)

(1) Servo Alarm Output (ALM)

This signal is output when an error is detected in the SERVOPACK.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	ALM	CN1-31, 32 (Factory setting)	ON (low level)	Normal SERVOPACK condition
			OFF (high level)	SERVOPACK alarm condition
■ IMPORTANT Always form an external circuit so this alarm output turns OFF the main circuit power supply to the SERVOPACK.				

(2) Alarm Reset

Type	Signal Name	Connector Pin Number	Name
Input	/ALM-RST	CN1-44	Alarm Reset
When a servo alarm (ALM) has occurred and the cause of the alarm has been eliminated, the alarm can be reset by turning this signal (/ALM-RST) from OFF (high level) to ON (low level). This signal can be allocated to other pin numbers with Pn50B. For details on the procedure, refer to *3.3.2 Input Circuit Signal Allocation*. The /ALM-RST signal cannot be constantly enabled by the allocation of an external input signal. Reset the alarm by changing the signal from high level to low level. The alarm can also be reset from the panel operator or digital operator. Refer to *3.1.2 Key Names and Functions* for details.			

IMPORTANT

1. Some encoder-related alarms cannot be reset with the /ALM-RST signal input. To reset these alarms, turn OFF the control power supply.
2. When an alarm occurs, always eliminate the cause before resetting the alarm. The methods for troubleshooting alarms are described in *6.1.5 Troubleshooting of Alarm and Warning*.

(3) Alarm Code Output

Type	Signal Name	Connector Pin Number	Meaning
Output	ALO1	CN1-37	Alarm code output
Output	ALO2	CN1-38	Alarm code output
Output	ALO3	CN1-39	Alarm code output
Output	SG	CN1-1	Signal ground for alarm code output
These open-collector signals output alarm codes. The ON/OFF combination of these output signals indicates the type of alarm detected by the servomotor. Use these signals to display alarm codes at the host controller. Refer to *6.1.1 Alarm Display Table* for details on alarm code output.			

4.13.2 Warning Output (/WARN)

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/WARN	Must be allocated	ON (high level)	Normal state
			OFF (low level)	Warning state
This output signal displays warnings before an overload (A.710) or regenerative overload (A.320) alarm is output. For use, the /WARN signal must be allocated with parameter Pn50F. For details, refer to *3.3.3 Output Circuit Signal Allocation*.				

- Related Parameters

The following parameter is used to select the alarm code output.

Parameter		Description
Pn001	n.**0**□□□	Outputs alarm codes alone for alarm codes ALO1, ALO2, and ALO3.
	n.**1**□□□	Outputs both alarm and warning codes for alarm codes ALO1, ALO2, and ALO3, and outputs an alarm code when an alarm occurs.
• Refer to *4.13.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)* for alarm code descriptions. • Refer to *6.1.2 Warning Display* for the ON/OFF combinations of ALO1, ALO2, and ALO3 when a warning code is output.		

4.13.3 Running Output Signal (/TGON)

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 (Factory setting)	ON (low level)	Linear servomotor is operating (Motor speed is above the setting in Pn581).
			OFF (high level)	Linear servomotor is not operating (Motor speed is below the setting in Pn581).
This signal is output to indicate that the linear servomotor is currently operating above the setting in parameter Pn581. The /TGON signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *3.3.3 Output Circuit Signal Allocation*.				

- Related Parameter

Pn581	Zero-Speed Level		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 5000	1 mm/s	20	Immediately
Set the range in which the running output signal (/TGON) is output in this parameter. When the linear servomotor movement speed is above the value set in the Pn581, it is judged to be linear servomotor moving and the running output signal (/TGON) is output. The movement detection signal can also be checked on the digital operator. For details, refer to *3.1.4 Status Display* and *3.4.1 List of Monitor Modes*.				

4.13.4 Servo Ready (/S-RDY) Output

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/S-RDY	CN1-29, 30 (Factory setting)	ON (low level)	Servo is ready.
			OFF (high level)	Servo is not ready.

This signal indicates that the SERVOPACK received the servo ON signal and completed all preparations.

It is output when there are no servo alarms and the main circuit power supply is turned ON.

If no hall sensor is set, the polarity detection must be completed.

The servo ready signal condition can also be checked on the digital operator. For details, refer to *3.1.4 Status Display* and *3.4.1 List of Monitor Modes*.

The /S-RDY signal can be allocated to another output terminal with parameter Pn50E. For details, refer to *3.3.3 Output Circuit Signal Allocation*.

5

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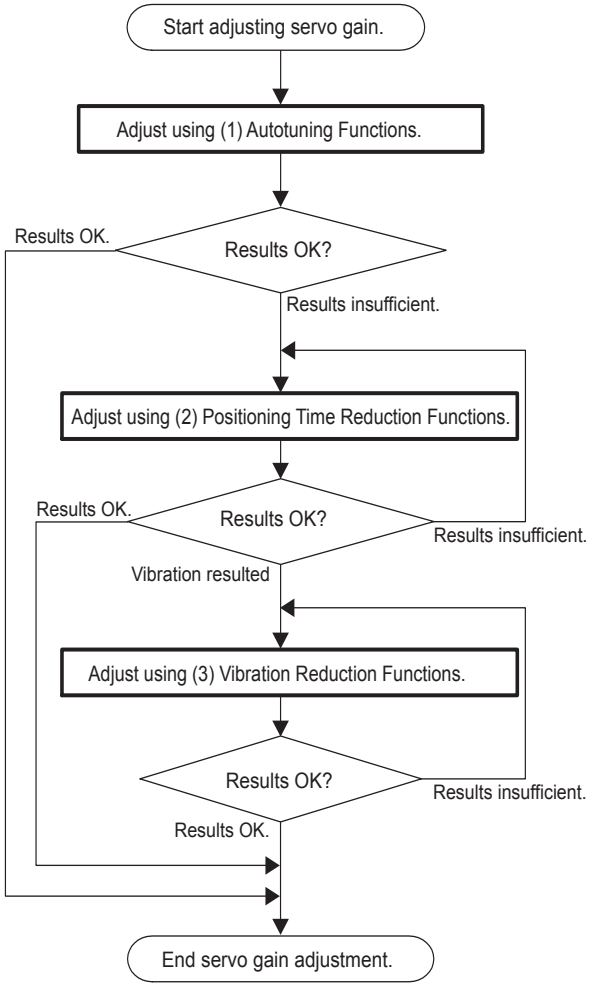
5.1 Autotuning

5.1.1 Servo Gain Adjustment Methods

The SERVOPACK has the servo gains to determine the servo response characteristics. The servo gains are set in the parameters. The parameters are designated for each function as shown in *5.1.2 List of Servo Adjustment Functions*.

The servo gains are factory-set to stable values, and responsiveness can be increased depending on the actual machine conditions. The following flowchart shows an overview procedure for adjusting the servo gains to reduce the positioning time for position control. Follow this flowchart to effectively adjust the servo gains. For functions in bold lines in the flowchart, select the adjustment method according to the client's intent using *5.1.2 List of Servo Adjustment Functions*.



If the desired responsiveness cannot be achieved adjusting according to the servo gain adjustment methods, consider the following possible causes.

- Autotuning does not suit the operating conditions.
  Adjust the servo gains manually. Refer to *5.3 Manual Tuning*.
- The selection of settings for the positioning time reduction functions or vibration reduction functions are not appropriate.
  Each function may not be effective for all machines due to machine characteristics or operating conditions.
  Use other positioning time reduction function or vibration reduction function.

5.1.2 List of Servo Adjustment Functions

(1) Autotuning Functions

Autotuning calculates the load mass, which determines the servo responsiveness, and automatically adjusts parameters, such as the Speed Loop Gain Kv (Pn100), Speed Loop Integral Time Constant Ti (Pn101), Position Loop Gain Kp (Pn102), and Force Reference Filter Time Constant Tf (Pn401). Refer to the following table to select the appropriate autotuning function for your desired purpose and adjust the servo gains.

Function Name and Related Parameters	Description	Guidelines for Selection	Reference Section
Online Autotuning Pn110.0 Fn001 Fn007	This function automatically measures the machine characteristics and sets the required servo gains accordingly. This function allows beginners to adjust the servo gains easily. The load mass is calculated during operation for a user reference, and the servo gains (Kv, Ti, Kp, and Tf) are set according to the Machine Rigidity Setting (Fn001).	Only the minimum number of parameters must be set for autotuning using a normal operation reference.	5.2

(2) Positioning Time Reduction Functions

Function Name and Related Parameters	Description	Features	Valid Control Modes	Reference Section
Feed-forward Pn109 Pn10A	Feed-forward compensation for the position reference is added to the speed reference.	Adjustment is easy. The system will be unstable if a large value is set, possibly resulting in overshooting or vibration.	Position	5.4.1
Force feed-forward Pn002 Pn400	Inputs force feed-forward to the force reference input terminal and adds to the internal force reference at the speed control.		Speed	5.4.2
Speed feed-forward Pn207 Pn300	Inputs speed feed-forward to the speed reference input terminal and adds to the internal speed reference at the position control.		Position	5.4.3
Mode Switch (P/PI Switching) Pn10B Pn10C Pn10D Pn10E Pn10F	Switches from PI control to P control using the value of an internal servo variable in a parameter (force, speed, acceleration, or position error) as a threshold value.	The setting for automatic switching between PI and P control is easy.	Position Speed	5.4.5
Speed Feedback Compensation Pn110 Pn111	Compensates the motor speed using an observer.	Adjustment is easy because the compensation can be set as a percentage. If the speed loop gain increases, the position loop gain also increases, however sometimes the servo rigidity decreases.	Position Speed	5.4.8
Gain Switching Pn100 Pn101 Pn102 Pn104 Pn105 Pn106	Uses the external signals to change each parameter for speed loop gain (Kv), speed loop integral time constant (Ti), and position loop gain (Kp.)	–	Position Speed	5.4.9

(3) Vibration Reduction Functions

Function Name and Related Parameters	Description	Features	Valid Control Modes	Reference Section
Soft Start Pn305 Pn306	Converts a stepwise speed reference to a constant acceleration or deceleration for the specified time interval.	A constant acceleration/deceleration is achieved for smoother operation. The operation time is increased for the specified time.	Speed	4.7.4
Acceleration/ Deceleration Filters Pn204 Pn207	A 1st-order delay filter for the position reference input.	Enables smooth operation. The reference time increases by the filter delay time even after the reference input has been completed.	Position	4.8.4
Movement Average Filter Pn207 Pn208	A movement averaging filter for the position reference input.	Enables smooth operation. The reference time increases by the filter delay time even after the reference input has been completed.	Position	4.8.4
Speed Feedback Filter Pn308	A standard 1st-order delay filter for the speed feedback.	The feedback speed is smoother. The response is delayed if a large value is set.	Position Speed	5.4.7
Speed Reference Filter Pn307	A 1st-order delay filter for the speed reference.	The speed reference is smoother. The response is delayed if a large value is set.	Speed	4.7.5
Force Reference Filter Pn401	A 1st-order delay filter for the force reference.	This filter is effective in essentially all frequency bands. The response is delayed if a large value (low frequency) is set.	Position Speed Force	5.4.10
Notch Filter Pn409 Pn40B*	Notch filters can be set for the force reference.	Mainly effective for vibration between 500 and 2,000 Hz. Instability will result if the setting is not correct.	Position Speed Force	5.4.10

* Pn40B is valid for the software version 32 or later.

5.2 Online Autotuning

5.2.1 Online Autotuning

Online autotuning calculates the load mass during operation of the SERVOPACK and sets parameters so that the servo gains consistent with the Machine Rigidity (Fn001) are achieved.

Online autotuning may not be effective in the following cases.

- The load mass varies in less than 200 ms.
- The motor speed is lower than 100 mm/s or the acceleration reference is very even.
- Load rigidity is low and mechanical vibration occurs easily or friction is high.
- The speed reference is a stepwise reference.

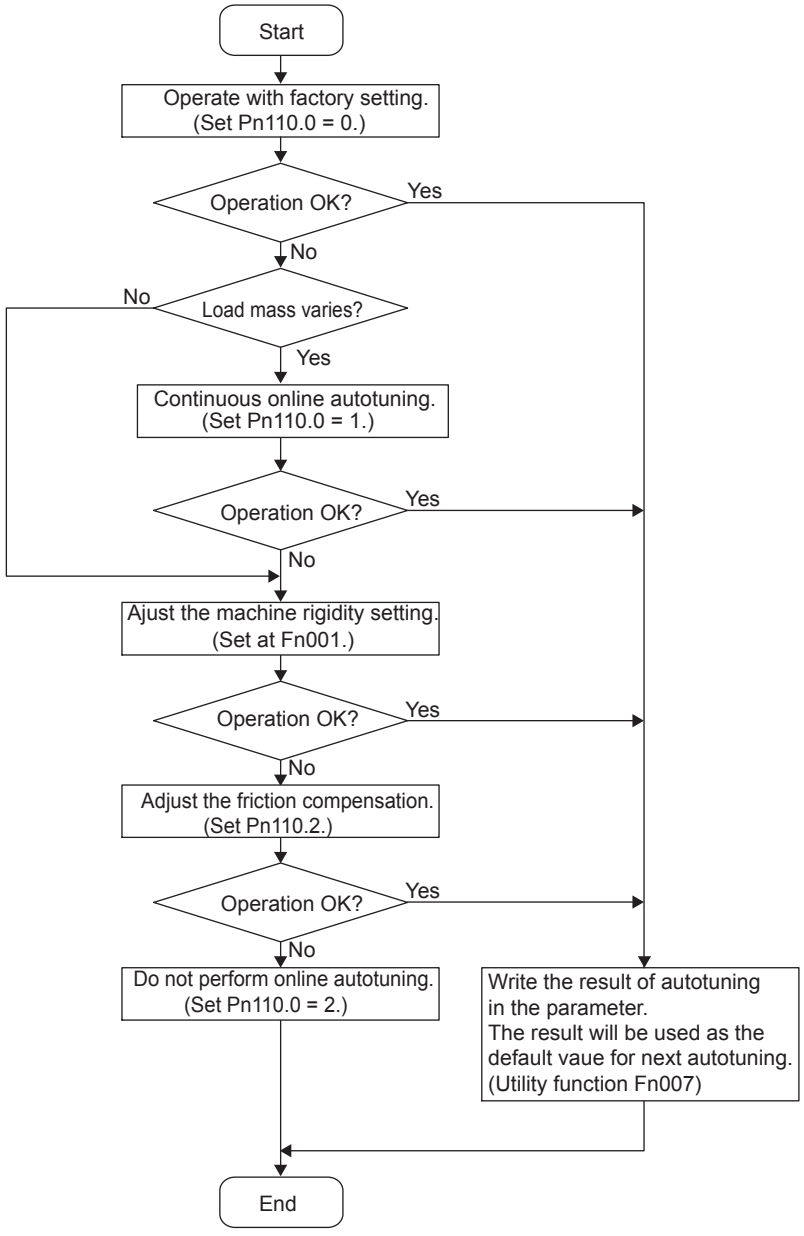
If the condition meets one of the above cases or the desired operation cannot be achieved by the online autotuning, calculate the load mass on the basis of the machine specifications or using the mass detection function of Yaskawa's servodrive supporting tool "SigmaWin+." Set the value in Pn103 and perform the adjustment manually.

The following utility function is also available for the online autotuning.

Fn007: Writes the load mass calculated by the online autotuning in Pn103 and uses as the default value for the next calculation.

5.2.2 Online Autotuning Procedure

⚠ WARNING
• Do not perform extreme adjustment or setting changes causing unstable servo operation. Failure to observe this warning may result in injury and damages to the machine. • Adjust the gains slowly while confirming motor operation.



5.2.3 Selecting the Online Autotuning Execution Method

There are three methods that can be used for online autotuning: At start of operation, constantly, and none. The selection method is described next.

Pn110	Online Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	After restart

Parameter		Meaning
Pn110	n.□□□**0**	Online autotuning is performed only after the first time power is turned ON. (Factory Setting)
	n.□□□**1**	Online autotuning (mass calculations) is performed continuously.
	n.□□□**2**	Online autotuning is not performed.

The factory setting is n.□□□0. This setting is recommended for applications in which the load mass does not change much or if the load mass is not known. The mass calculated at the beginning of operation is used continously. In this case, differences in machine status and operation references at the beginning of operation may cause minor differences in the calculation results of the load mass, causing differences in the servo responsiveness each time the power supply is turned ON. If this occurs, overwrite the mass ratio in Pn103 using the utility function Fn007 (Writing to EEPROM mass ratio data obtained from online autotuning), and set Pn110 to n.□□□2 to disable online autotuning.

The setting n.□□□1 is used when the load mass varies constantly. This setting enables a consistent responsiveness even when the load mass changes. If the load mass changes in less than 200 ms, however, the autotuning accuracy will deteriorate, in which case Pn110.0 should be set to 0 or 2.

The setting n.□□□2 is used when online autotuning is not possible, when the load mass is known and the mass ratio is set in Pn103 to perform the adjustment manually, or any other time the online autotuning function is not going to be used.

5.2.4 Machine Rigidity Setting for Online Autotuning

There are ten machine rigidity settings for online autotuning. When the machine rigidity setting is selected, the servo gains (Speed Loop Gain, Speed Loop Integral Time Constant, Position Loop Gain, and Force Reference Filter Time Constant) are determined automatically. The factory setting for the machine rigidity setting is 4. The speed loop is suitable for PI or I-P control.

When parameter Pn10B.1 is 0, PI control will be used and when Pn10B.1 is 1, I-P control will be used. To validate the setting, however, the power supply must be turned OFF and then back ON.

After having validated the setting, always set the machine rigidity setting.

When setting the machine rigidity after having changed the position loop gain (Pn102), the value closest to the set position loop gain is displayed as the initial value of machine rigidity.

- Speed Loop PI Control

Machine Rigidity Setting Fn001	Position Loop Gain [s^{-1}] Pn102	Speed Loop Gain [Hz] Pn100	Speed Loop Integral Time Constant [0.01 ms] Pn101	Force Reference Filter Time Constant [0.01 ms] Pn401
1	15	15	6000	250
2	20	20	4500	200
3	30	30	3000	130
4	40	40	2000	100
5	60	60	1500	70
6	85	85	1000	50
7	120	120	800	30
8	160	160	600	20
9	200	200	500	15
10	250	250	400	10

If the machine rigidity setting is greater, the servo gain will increase and positioning time will decrease. If the setting is too large, however, vibration may result depending on the machine configuration. Set the machine rigidity starting at a low value and increasing it within the range where vibration does not occur.

5.2.5 Method for Changing the Machine Rigidity Setting

The machine rigidity setting is changed in utility function mode using parameter Fn001. The procedure is given below.

Step	Display after Operation	Digital Operator	Panel Operator	Description
1	Fn000	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2	Fn001	∧ ∨		Press the Up or Down Cursor Key to select Fn001. *The digit that can be set will blink.
3	d0004	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more. The display shown at the left will appear and the rigidity for online autotuning can be set.
4	d0004 UP ↓ ↑ DOWN d0005	∧ ∨		Press the Up or Down Cursor Key to select the machine rigidity setting.
5	donE	DSPL SET (DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The rigidity setting will be changed and "donE" will blink on the display for about one second.
6	d0005	About one second later		After "donE" is displayed, the setting will be displayed again.
7	Fn001	DATA ENTER (DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for more than one second to return to the Fn001 display of the utility function mode.

This completes changing the machine rigidity setting for online autotuning.

5.2.6 Saving the Results of Online Autotuning

⚠ CAUTION

- Always set the correct mass ratio when online autotuning is not used.
  If the mass ratio is set incorrectly, vibration may occur.

For online autotuning, the most recent load mass is calculated and the control parameters are adjusted to achieve response suitable for the machine rigidity setting. When online autotuning is performed, the Position Loop Gain (Pn102), Speed Loop Gain (Pn100), and Speed Loop Integral Time Constant (Pn101) are saved. When the power supply to the SERVOPACK is turned OFF, however, the calculated load mass is lost and the factory setting is used as the default value to start autotuning the next time the power supply is turned ON.
To use the calculated load mass as the default value the next time the power supply is turned ON, the utility function mode parameter Fn007 (Writing to EEPROM mass ratio data obtained from online autotuning) can be used to save the most recent value in parameter Pn103 (Mass Ratio). The mass ratio is given as the mass ratio (%) of the coil assembly mass of the linear servomotor.

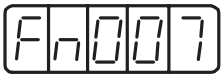
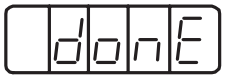
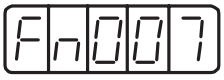
Pn103	Mass Ratio		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 10,000 (0 to 20,000)*	1%	0	Immediately

$$\text{Mass ratio} = \left(\frac{\text{Load mass } (M_L) \text{ (includes coil assembly)}}{\text{Linear servomotor coil assembly mass } (M_M)} - 1 \right) \times 100\ (\%)$$

The factory setting for the mass ratio is 0% (no-load operation of linear servomotor without connecting a machine).

5.2.7 Procedure for Saving the Results of Online Autotuning

The following procedure is used to save the results of online autotuning.

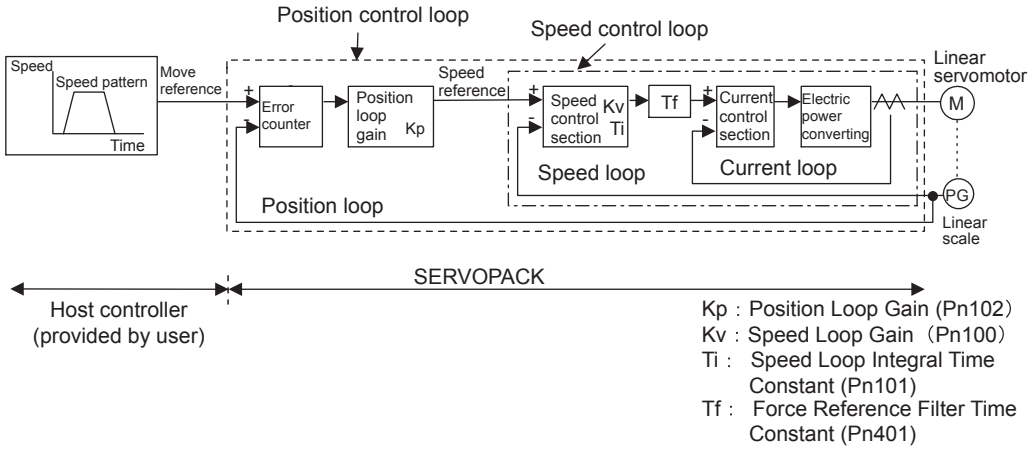
Step	Display after Operation	Digital Operator	Panel Operator	Description
1		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key to select the utility function mode.
2				Press the Up or Down Cursor Key to select parameter Fn007. *The digit that can be set will blink.
3		(DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more. The display at the left will appear for a mass ratio of 200%.
4		(DSPL/SET Key)	MODE/SET (MODE/SET Key)	Press the DSPL/SET or MODE/SET Key. The mass ratio will be saved. When completed, “donE” will blink for about one second.
5		About one second later		After “donE” is displayed, the mass ratio will be displayed again.
6		(DATA/ENTER Key)	DATA/◀ (DATA/SHIFT Key) (Press at least 1 s.)	Press the DATA/ENTER or DATA/SHIFT Key for one second or more to return to the Fn007 display of the utility function mode.

This completes saving the default value for the mass ratio for online autotuning. The next time the power supply is turned ON, the value that was saved for the Mass Ratio (Pn103) will be used to start online autotuning.

5.3 Manual Tuning

5.3.1 Explanation of Servo Gain

The block diagram for position control is as follows:



To adjust the servo gain manually, understand the configuration and characteristics of the SERVOPACK and adjust the servo gain parameters one by one. If one parameter is changed, it is almost always necessary to adjust the other parameters. It will also be necessary to make preparations such as setting up a measuring instrument to monitor the output waveform from the analog monitor.

The SERVOPACK has three feedback loops (i.e., position loop, speed loop, and current loop). The innermost loop must have the highest response and the middle loop must have higher response than the outermost. If this principle is not followed, it will result in vibration or responsiveness decreases.

The SERVOPACK is designed to ensure that the current loop has good response performance. The user need to adjust only position loop gain and speed loop gain.

5.3.2 Servo Gain Manual Tuning

The SERVOPACK has the following parameters for the servo gains. Setting the servo gains in the parameters can adjust the servo responsiveness.

- Pn100: Speed loop gain (Kv)
- Pn101: Speed loop integral time constant (Ti)
- Pn102: Position loop gain (Kp)
- Pn401: Force reference filter time constant (Tf)

For the position and speed control, the adjustment in the following procedure can increase the responsiveness. The positioning time in position control can be reduced.

Step	Explanation
1	Set correctly the mass ratio (Pn103). The utility function Fn007 can be used after the online autotuning.
2	Increase the speed loop gain (Pn100) to within the range so that the machine does not vibrate. At the same time, decrease the speed loop integral time constant (Pn101).
3	Adjust the force reference filter time constant (Pn401) so that no vibration occurs.
4	Repeat the steps 1 and 2. Then reduce the value for 10 to 20%.
5	For the position control, increase the position loop gain (Pn102) to within the range so that the machine does not vibrate.

Perform the manual tuning in the following cases.

- To increase the servo gains more than the values set by the online autotuning.
- To determine the servo gains and mass ratio by the user.

Start the manual tuning from the factory setting or the values set by the online autotuning. Prepare measuring instruments such as memory recorder so that the signals can be observed from the analog monitor (CN5) such as "Force Reference" and "Motor Speed," and "Position Error Monitor" for the position control. (Refer to *5.5 Analog Monitor*.) The servodrive supporting tool "SigmaWin+" allows you to observe such signals. Prepare either of them.

5.3.3 Position Loop Gain

Pn102	Position Loop Gain (Kp)			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately

The responsiveness of the position loop is determined by the position loop gain. The responsiveness increases and the positioning time decreases when the position loop gain is set to a higher value. In general, the position loop gain cannot be set higher than natural vibrating frequency of the mechanical system, so the mechanical system must be made more rigid to increase its natural vibrating frequency and allow the position loop gain to be set to a high value.

If the position loop gain (Pn102) cannot be set high in the mechanical system, an overflow alarm may occur during high speed operation. In this case, increase the values in the following parameter to suppress detection of the overflow alarm.

Pn505	Overflow Level			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 32,767	256 reference units	1,024	Immediately

This parameter's new setting must satisfy the following condition.

$$Pn505 \geq \frac{\text{Max. feed speed (reference units/s)}}{Pn102} \times 2.0$$

5.3.4 Speed Loop Gain

Pn100	Speed Loop Gain (Kv)		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately

This parameter determines the responsiveness of the speed loop. If the speed loop's responsiveness is too low, it will delay the outer position loop and cause overshooting and vibration of the speed reference. The SERVOPACK will be most stable and responsive when the speed loop gain is set as high as possible within the range that does not cause vibration in the mechanical system. The value of speed loop gain is the same as the set value of Pn100 if the moment of inertia ratio in Pn103 has been set correctly.

Pn103	Mass Ratio		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	0 to 10,000 (0 to 20,000)*	%	0	Immediately	

$$\text{Pn103 set value} = \left(\frac{\text{Load mass } (M_L) \text{ (includes coil assembly)}}{\text{Linear servomotor coil assembly mass } (M_M)} - 1 \right) \times 100\ (\%)$$

The factory setting is Pn103=0. Before adjusting the servo, determine the mass ratio with the equation above and set parameter Pn103.

* The setting range for the software version 32 or later

5.3.5 Speed Loop Integral Time Constant

Pn101	Speed Loop Integral Time Constant (Ti)		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200 (0.15 to 512.00 ms)	0.01 ms	2,000 (20.00 ms)	Immediately

The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element causes a delay in the SERVOPACK. If the time constant is set too long, overshooting will occur, which results in a longer positioning settling time or responsiveness decreases.

The estimated set value for Pn101 depends on the speed loop control method with Pn10B.1, as shown below.

INFO

■ Selecting the Speed Loop Control Method (PI Control or I-P Control)

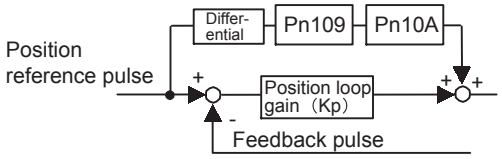
Generally, I-P control is more effective in high-speed positioning or high-speed/precision manufacturing applications. The position loop gain is lower than it would be in PI control, so shorter positioning times and smaller arc radii can be achieved. On the other hand, PI control is generally used when switching to P control fairly often with a mode switch or other method.

5.4 Servo Gain Adjustment Functions

5.4.1 Feed-forward Reference

Pn109	Feed-forward			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 100	%	0	Immediately
Pn10A	Feed-forward Filter Time Constant			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 6,400 (0.00 to 64.00 ms)	0.01ms	0	Immediately

Applies feed-forward compensation in position control inside the SERVOPACK. Use this parameter to shorten positioning time. Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.



5.4.2 Force Feed-forward

Parameter		Meaning
Pn002	n.□□□**0**	Disabled
	n.□□□**2**	Uses T-REF terminal for force feed-forward input.

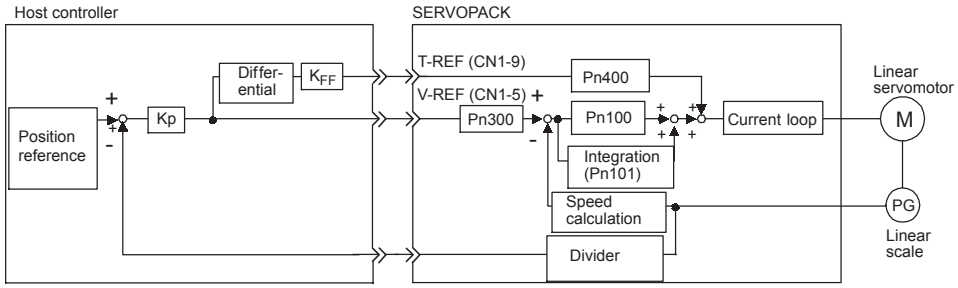
Pn400	Force Reference Input Gain		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	10 to 100 (1.0 to 10.0V/Rated force)	0.1V/Rated force	30	Immediately

The force feed-forward function is valid only in speed control (analog reference).

The force feed-forward function shortens positioning time, differentiates a speed reference at the host controller to generate a force feed-forward reference, and inputs the force feed-forward reference together with the speed reference to the SERVOPACK.

Too high a force feed-forward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

Connect a speed reference signal line to V-REF (CN1-5 and -6) and a force forward-feed reference to T-REF (CN1-9 and -10) from the host controller.



Kp: Position loop gain

K_{FF}: Feed-forward gain

Force feed-forward is set using the parameter Pn400.

The factory setting is Pn400 = 30. If, for example, the force feed-forward value is ±3V, then, the force is limited to ±100% of the rated force.

The force feed-forward function cannot be used with force limiting by analog voltage reference described in *4.11.3 Force Limiting Using an Analog Voltage Reference*.

5.4.3 Speed Feed-forward

Parameter		Meaning
Pn207	n.☐☐**0**☐	Disabled
	n.☐☐**1**☐	Uses V-REF terminal for speed feed-forward input.

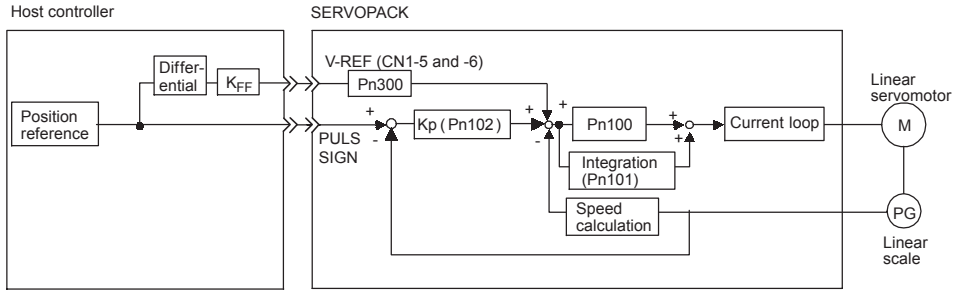
Pn300	Speed Reference Input Gain		Speed	Position	Force
	Setting Range	Setting Unit	Factory Setting	Setting Validation	
	150 to 3,000 (1.50 to 30.00 V/Rated speed)	0.01 V/Rated speed	600	Immediately	

The speed feed-forward function uses analog voltages and is valid only in position control.

The speed feed-forward function is used to shorten positioning time. The host controller differentiates the position reference to generate the feed-forward reference, and inputs the feed-forward reference together with the position reference to the SERVOPACK.

Too high a speed feed-forward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

Connect a position reference signal line to PULS and SIGN (CN1-7, -8, -11, and -12) and a speed feed-forward reference signal line to V-REF (CN1-5 and -6) from the host controller.



Kp: Position loop gain

K_{FF}: Feed-forward gain

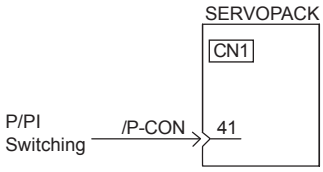
Speed feed-forward value is set using the parameter Pn300.

The factory setting is Pn300 = 600. If, for example, the speed feed-forward value is ±6V, then the speed is limited to the rated speed.

5.4.4 Proportional Control Operation (Proportional Operation Reference)

If parameter Pn000.1 is set to 0 or 1 as shown below, the /P-CON input signal serves as switch to change between PI control and P control.

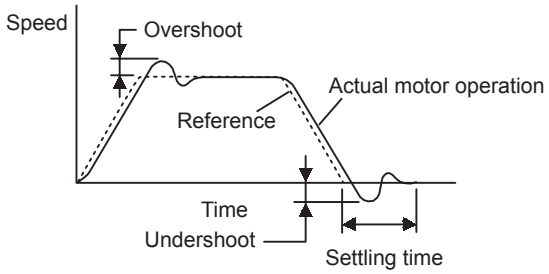
- PI control: Proportional/Integral control
- P control: Proportional control

<table>
<tr><th colspan="2">Parameter</th><th colspan="3">Control Mode</th></tr>
<tr><td rowspan="2">Pn000</td><td>n.☐☐0☐</td><td>Speed Control</td><td rowspan="2">Effective in speed control or position control.
Input signal /P-CON (CN1-41) is used to select PI control or P control.
CN1-41 is OFF (H level). → PI control
CN1-41 is ON (L level). → P control</td><td rowspan="2"> 
</td></tr>
<tr><td>n.☐☐1☐</td><td>Position Control</td></tr>
<tr><td colspan="5">• When sending references from the host controller to the SERVOPACK, P control mode can be selected from the host controller for particular operating conditions. This mode switching method can be used to suppress overshooting and shorten the settling time. Refer to 5.4.5 Using the Mode Switch (P/PI Switching) for more details on inputting the /P-CON signal and switching the control mode for particular operating conditions.
• If PI control mode is being used and the speed reference has a reference offset, the linear servomotor may move very slowly and fail to stop even if 0 is specified as the speed reference. In this case, use P control mode to stop the linear servomotor.</td></tr>
</table>

5.4.5 Using the Mode Switch (P/PI Switching)

Use the mode switch (P/PI switching) function in the following cases:

- To suppress overshooting during acceleration or deceleration (for speed control)
- To suppress undershooting during positioning and reduce the settling time (for position control)



The mode switch function automatically switches the speed control mode from PI control mode to P control[1] mode based on a comparison between the servo's internal value and a user-set detection level.

IMPORTANT

1. The mode switch function is used in very high-speed positioning when it is necessary to use the servodrive near the limits of its capabilities. The speed response waveform must be observed to adjust the mode switch.
2. For normal use, the speed loop gain and position loop gain set by autotuning provide sufficient speed/position control. Even if overshooting or undershooting occur, they can be suppressed by setting the host controller's acceleration/deceleration time constant, the SERVOPACK's Soft Start Acceleration/Deceleration Time (Pn305, Pn306), or Position Reference Acceleration/Deceleration Time Constant (Pn204).

(1) Selecting the Mode Switch Setting

The SERVOPACK provides the following four mode switch settings (0 to 3). Select the appropriate mode switch setting with parameter Pn10B.0.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	Setting Unit
Pn10B	n.□□□**0**	Use a force reference level for detection point. (Factory Setting)	Pn10C	Percentage to the rated force
	n.□□□**1**	Use a speed reference level for detection point.	Pn181	Servomotor speed: mm/s
	n.□□□**2**	Use an acceleration level for detection point.	Pn182	Servomotor acceleration: 10 mm/s^2
	n.□□□**3**	Use a position error pulse for detection point.	Pn10F	Reference unit
	n.□□□**4**	Do not use the mode switch function.	–	–
Select a condition to execute the mode switch (P/PI switching). (Setting is validated immediately.)				

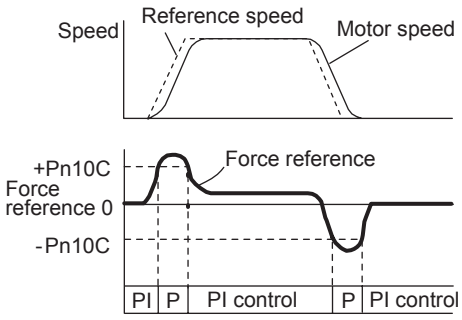
TERMS

[1] From PI control to P control

PI control means proportional/integral control and P control means proportional control. In short, switching "from PI control to P control" reduces effective servo gain, making the SERVOPACK more stable.

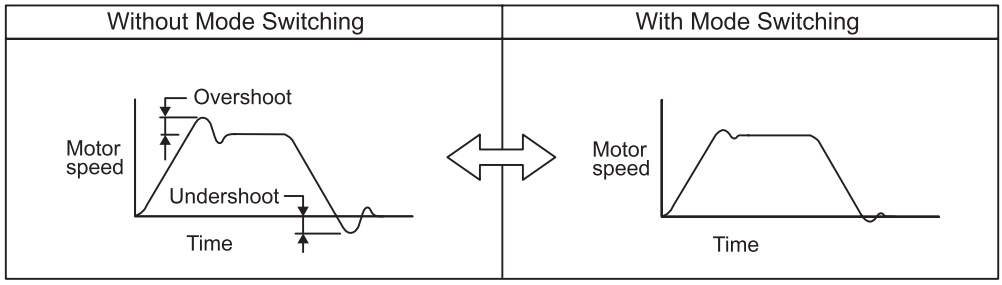
Using the Force Reference Level to Switch Modes (Factory Setting)

With this setting, the speed loop is switched to P control when the value of force reference input exceeds the force set in parameter Pn10C. The factory default setting for the force reference detection point is 200% of the rated force (Pn10C = 200).



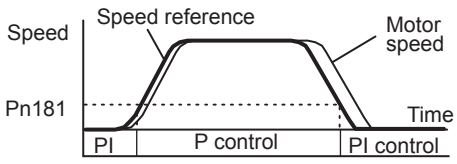
■ Operating Example

If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting of the motor speed.



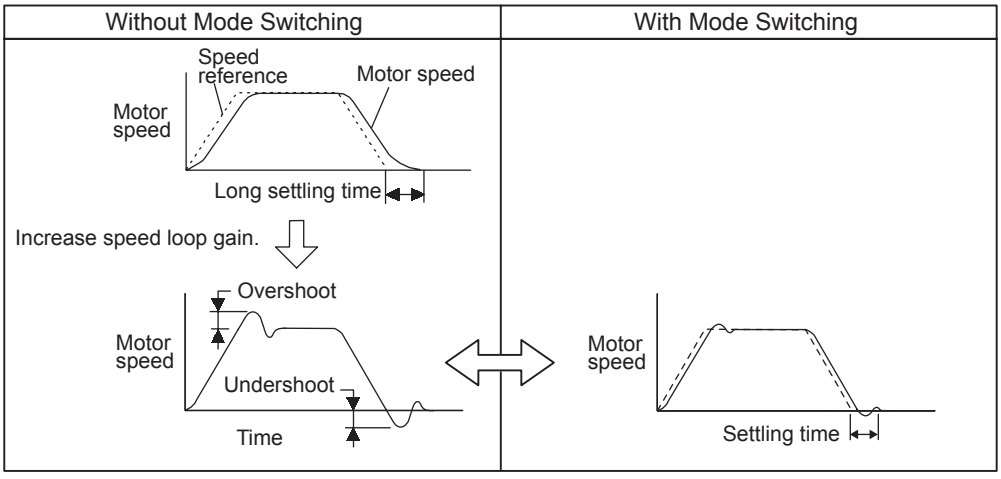
Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in parameter Pn181.



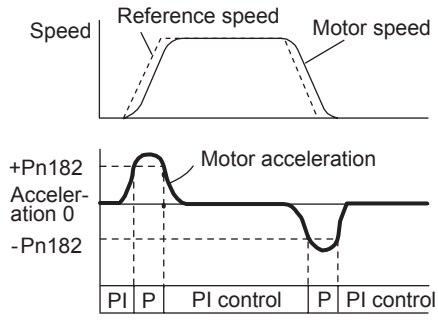
■ Operating Example

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



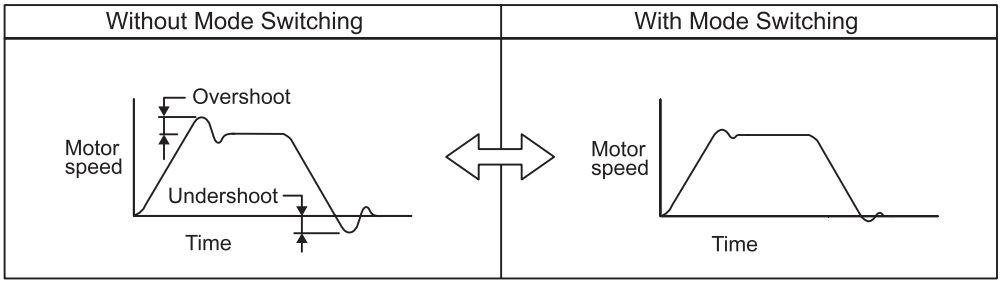
Using the Acceleration Level to Switch Modes

With this setting, the speed loop is switched to P control when the motor's acceleration rate exceeds the acceleration rate set in parameter Pn182.



■ Operating Example

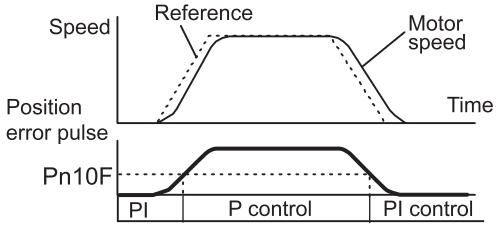
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting of the motor speed.



Using the Error Pulse Level to Switch Modes

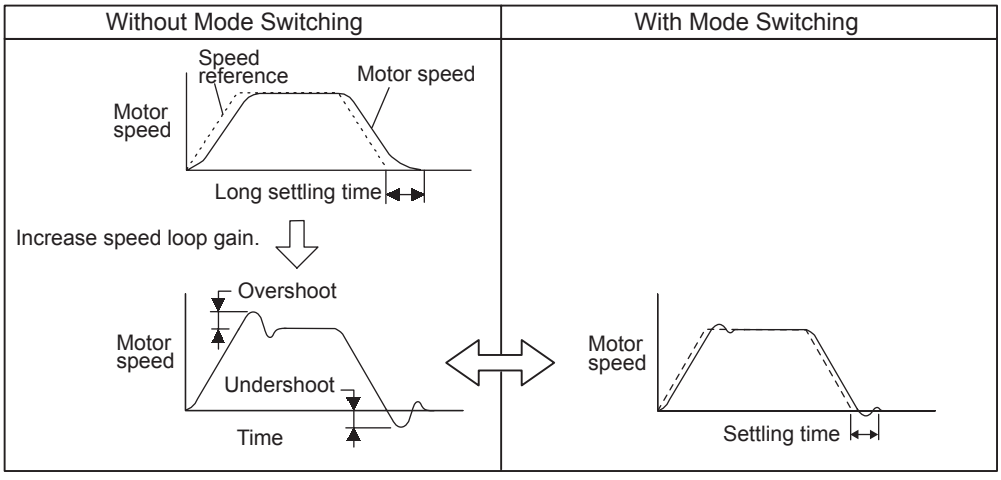
This setting is effective with position control only.

With this setting, the speed loop is switched to P control when the error pulse exceeds the value set in parameter Pn10F.



■ Operating Example

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



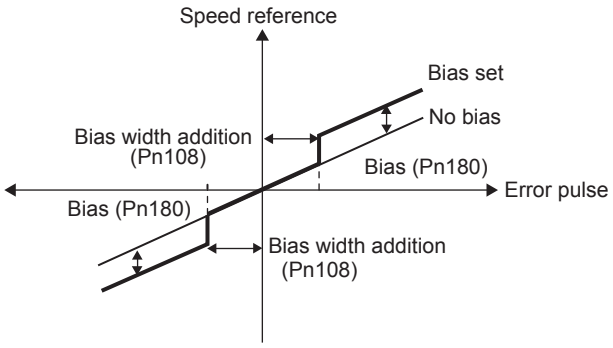
5.4.6 Setting the Speed Bias

The settling time for positioning can be reduced by setting the following parameters to add bias in the speed reference block in the SERVOPACK.

Pn180	Bias			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 450	1 mm/s	0	Immediately
Pn108	Bias Width Addition			Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 250	Reference units	7	Immediately

To reduce the positioning time, set these parameters based on the machine's characteristics.

The Bias Width Addition (Pn108) specifies when the Bias (Pn180) is added and the width is expressed in error pulse units. The bias input will be added when the error pulse value exceeds the width set in Pn108.



5.4.7 Speed Feedback Filter

Pn308	Speed Feedback Filter Time Constant		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535 (0.00 to 655.35 ms)	0.01 ms	0	Immediately
Sets the 1st-order filter for the speed loop's speed feedback. Makes the motor speed smoother and reduces vibration. If the set value is too high, it will introduce a delay in the loop and cause poor responsiveness.				

5.4.8 Speed Feedback Compensation

The speed feedback compensation can be used to reduce vibration and allow a higher speed loop gain to be set. In the end, the speed feedback compensation allows the positioning settling time to be reduced because the position loop gain can also be increased if the speed loop gain can be increased.

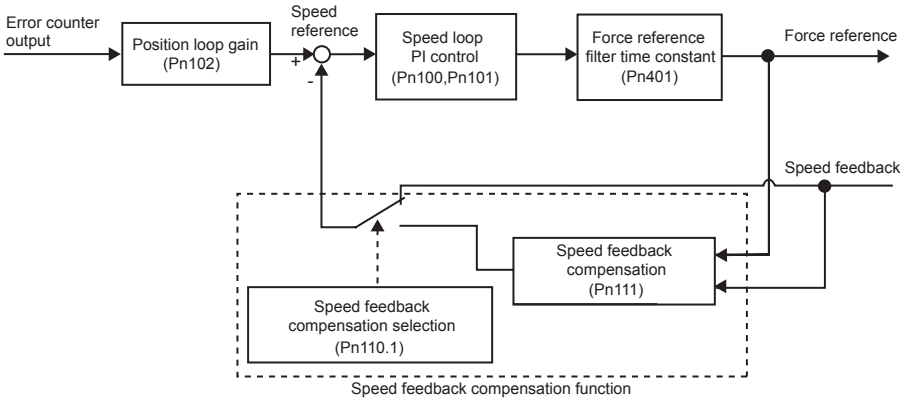
Pn110	Online Autotuning Switches		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	–	–	0010	After restart

Pn111	Speed Feedback Compensation		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 500	%	100	Immediately

Parameter		Function
Pn110	n.□□**0**□	Speed feedback compensation is used.
	n.□□**1**□	Speed feedback compensation is not used. (Standard speed feedback)

IMPORTANT

When this function is used, it is assumed that the mass ratio set in Pn103 is correct. Verify that the mass ratio has been set correctly.



(1) Adjustment Procedure

The following procedure explains how to adjust when the speed loop gain cannot be increased due to vibrations in the mechanical system. When adding a speed feedback compensation, observe the position error and force reference with the analog monitor while adjusting the servo gain. Refer to *5.5 Analog Monitor* on monitoring the position error and force reference.

1. Set parameter Pn110 to “0002” so that the following conditions are satisfied.
   - To use the speed feedback compensation
   - Not to use the online autotuning function
2. With PI control, gradually increase the Speed Loop Gain in Pn100 and reduce the Speed Loop Integral Time Constant Pn101, so that the setting the Position Loop Gain in Pn102 to the same value as that of the Speed Loop Gain in Pn100.

   Use the result from the following equation as an initial estimate when setting the Speed Loop Integral Time Constant in Pn101.

   $$\text{Speed loop integral time constant (Pn101)} = \frac{4000}{2\pi \times \text{Pn100}}$$

   Speed loop gain units: Hz

   Check the units when setting the Speed Loop Integral Time Constant in Pn101. The value in Pn101 is set in units of 0.01 ms.

   Set the same value for the speed loop gain and position loop gain even though the speed loop gain units (Hz) are different form the position loop gain units (1/s).
3. Repeat step 2 to increase the speed loop gain while monitoring the settling time with the analog monitor’s position error and checking whether vibration occurs in the force reference. If there is any vibrating noise or noticeable vibration, gradually increase the Force Reference Filter Time Constant in Pn401.
4. Gradually increase only the position loop gain. When it has been increased about as far as possible, then decrease the Speed Feedback Compensation in Pn111 from 100% to 90%. Then repeat steps 2 and 3.
5. Decrease the speed feedback compensation to a value lower than 90%. Then repeat steps 2 through 4 to shorten the settling time. If the speed feedback compensation is too low, however, the response waveform will oscillate.
6. Find the parameter settings that yield the shortest settling time without causing vibration or instability in the position error or force reference waveform being observed with the analog monitor.
7. The servo gain adjustment procedure is complete when the positioning time cannot be reduced any more.

IMPORTANT

The speed feedback compensation usually makes it possible to increase the speed loop gain and position loop gain. Once the speed loop gain and position loop gain have been increased, the machine may vibrate significantly and may even be damaged if the compensation value is changed significantly or Pn110.1 is set to “1” (i.e., speed feedback compensation disabled).

5.4.9 Switching Gain Settings

Gain switching by the external signal is possible with the SGDH SERVOPACK. For example, to use different gains while the servomotor is running or stopped, set two values in the gain settings 1 and 2 and switch the gains by the external signal.

(1) Gain Switching Input Signal

Type	Signal	Connector Pin No.	Setting	Meaning
Input	/G-SEL	Signal allocation required	OFF: H (high) level	Gain settings 1
			ON: L (low) level	Gain settings 2
To use the input signal, the input terminal must be allocated in the parameter Pn50D. Refer to *3.3.2 Input Circuit Signal Allocation*.				

(2) Switchable Gain Combinations

Turning ON and OFF the gain switching signal /G-SEL switches the gains as follows.

Gain Switching Signal (/G-SEL)	OFF (H Level)	ON (L Level)
Speed loop gain	Pn100	Pn104
Speed loop integral time constant	Pn101	Pn105
Position loop gain	Pn102	Pn106

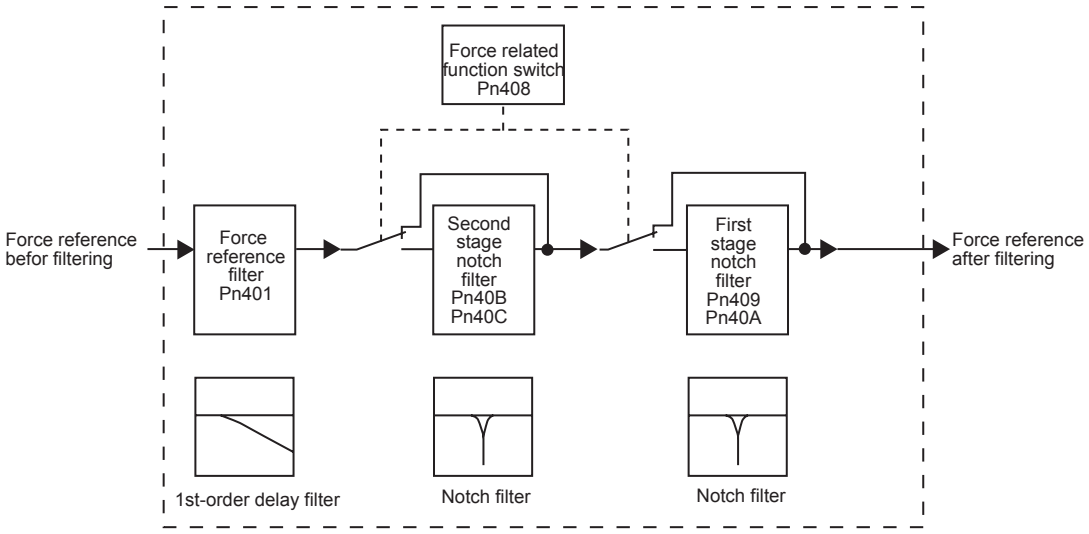
(3) Related Parameters

Parameter		Function
Pn50A	n.□□□**1**	Enables the input signal allocation for the sequence.
Set to allocate the gain switching signal (/G-SEL) to an input terminal.		

Pn100	Speed Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn101	Speed Loop Integral Time Constant		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200	0.01 ms	2,000	Immediately
Pn102	Position Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately
Pn104	2nd Speed Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	Hz	40	Immediately
Pn105	2nd Speed Loop Integral Time Constant		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	15 to 51,200	0.01 ms	2,000	Immediately
Pn106	2nd Position Loop Gain		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	1 to 2,000	1/s	40	Immediately

5.4.10 Force Reference Filter

As shown in the following diagram, the force reference filter contains one force reference filter and two notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled using the parameters.


Force related function switch Pn408
Force reference befor filtering
Force reference filter Pn401
Second stage notch filter Pn40B Pn40C
First stage notch filter Pn409 Pn40A
Force reference after filtering
1st-order delay filter
Notch filter
Notch filter

IMPORTANT

Software version earlier than 32 does not have the parameters for the First Stage Notch Filter Q Value (Pn40A) and the Second Stage Notch Filter (Pn40B and Pn40C).

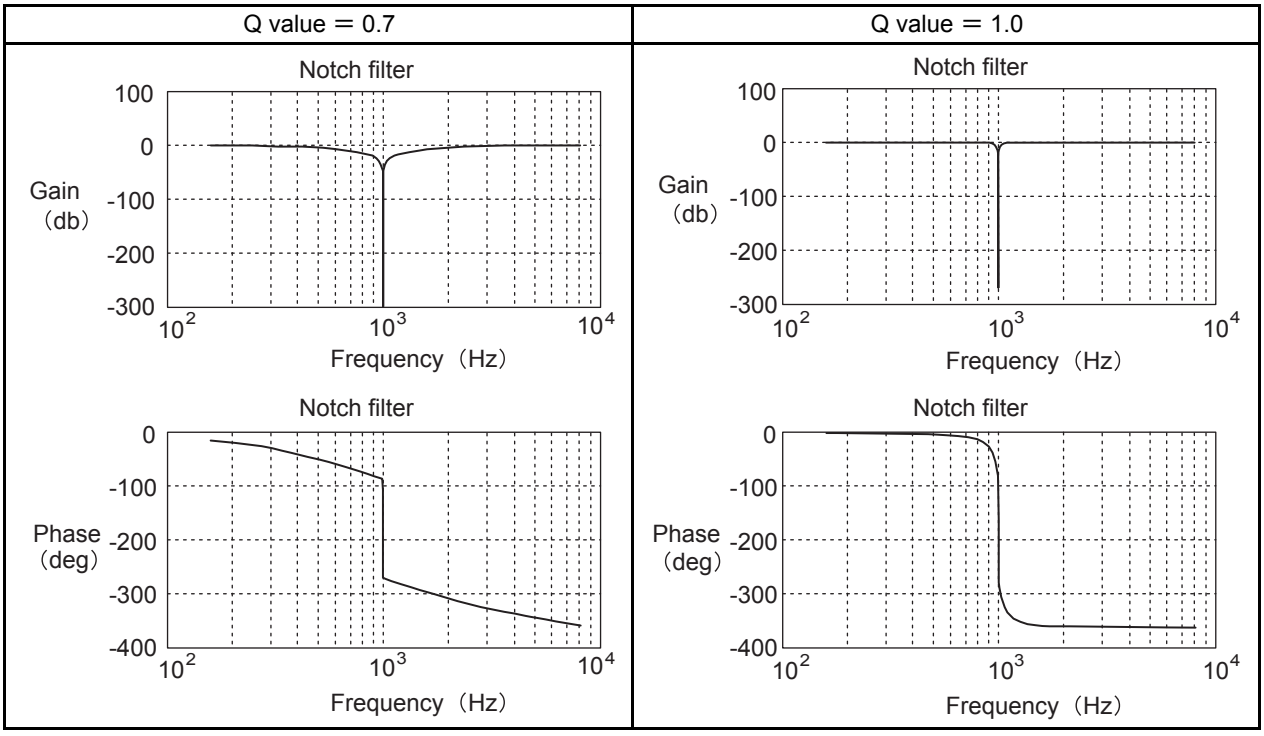
(1) Force Reference Filter

If you suspect that machine vibration is being caused by the servodrive, try adjusting the force reference filter time constant. This may stop the vibration. The lower the value, the better the speed control response, but there is a lower limit that depends on the machine conditions.

Pn401	Force Reference Filter Time Constant		Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0 to 65,535 (0.00 to 655.35 ms)	0.01 ms	100	Immediately

(2) Notch Filter

The notch filter can eliminate specific frequency vibration generated by sources such as resonances of ball screw axes. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency components near the notch frequency can be eliminated with this characteristics. A higher notch filter Q value produces a sharper notch and phase delay.



Parameter		Meaning
Pn408	n.□□□**0**	Disables the first stage notch filter.
	n.□□□**1**	Enables the first stage notch filter.
	n.□**0**□□	Disables the second stage notch filter.*
	n.□**1**□□	Enables the second stage notch filter.*
Enables the notch filter to be used. (The setting is validated immediately.)		

* Used for software version 32 or later.

Set the machine's vibration frequency in the parameter of a notch filter to be used.

Pn409	First Stage Notch Filter Frequency		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	Hz	2,000	Immediately
Pn40B	Second Stage Notch Filter Frequency *		Speed / Position / Force	
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	50 to 2,000	Hz	2,000	Immediately

* Used for software version 32 or later.

When the vibration is suppressed but overshooting occurs, increase the Q value and check whether the overshooting is corrected.

Pn40A	First Stage Notch Filter Q Value *		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0.50 to 4.00	0.01	0.70	Immediately
Pn40C	Second Stage Notch Filter Q Value *		Speed	Position
	Setting Range	Setting Unit	Factory Setting	Setting Validation
	0.50 to 4.00	0.01	0.70	Immediately

* Used for software version 32 or later.

IMPORTANT

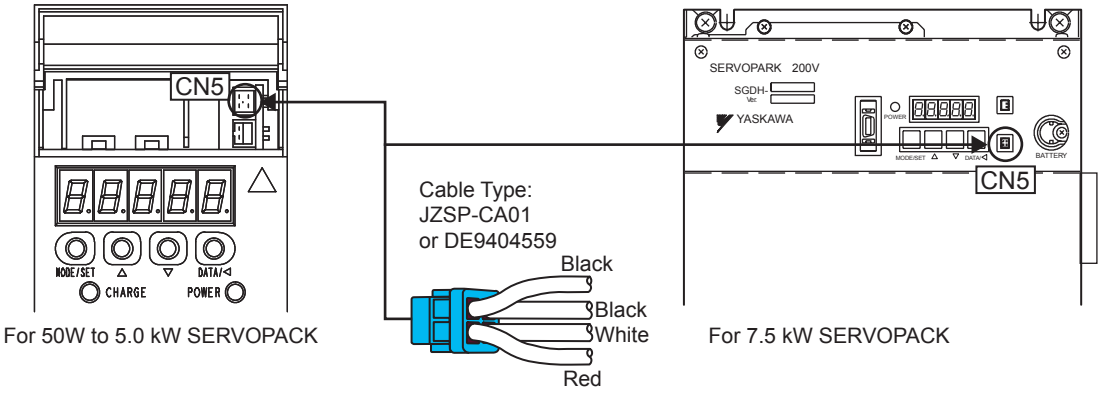
1. Sufficient precautions must be taken when setting the notch frequencies. Do not set the notch frequencies (Pn409 or Pn40B) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch frequency too close to the response frequncy may cause vibration and damage the machine. The speed loop response frequency is the value of the Speed Loop Gain (Pn100) when the Mass Ratio (Pn103) is set to the correct value.
2. Change the Notch Filter Frequency (Pn409 or Pn40B) only when the linear servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the linear servomotor is moving.

5.5 Analog Monitor

Signals for analog voltage references can be monitored.

To monitor analog signals, connect the analog monitor cable to the connector CN5.

The analog monitor signals can be selected by setting parameters Pn003.0 and Pn003.1.



Pin Number	Line Color	Signal Name	Monitoring Item with Factory Setting
1	Red	Analog monitor 2	Motor speed: 1 V/1000 mm/s
2	White	Analog monitor 1	Force reference: 1 V/100% rated force
3, 4	Black (2 lines)	GND (0 V)	–

- Related Parameters

The following signals can be monitored.

	Parameter		Function		
	Monitor 1	Monitor 2	Monitor Signal	Observation Gain	Remarks
Pn003	n.□□□**0**	n.□□**0**□	Motor speed	1 V / 1000 mm/s	Factory setting for Monitor 1
	n.□□□**1**	n.□□**1**□	Speed reference	1 V / 1000 mm/s	–
	n.□□□**2**	n.□□**2**□	Internal force reference	1 V / 100% rated force	Factory setting for Monitor 2
	n.□□□**3**	n.□□**3**□	Position error *	0.05 V / 1 reference unit	–
	n.□□□**4**	n.□□**4**□	Position error *	0.05 V / 100 reference units	–
	n.□□□**5**	n.□□**5**□	Position reference speed (converted to motor speed)	1 V / 1000 mm/s	–
	n.□□□**6**	n.□□**6**□	Motor speed	1 V / 250 mm/s	–
	n.□□□**7**	n.□□**7**□	Motor speed	1 V / 125 mm/s	–
	n.□□□**8**	n.□□**8**□	Reserved. Do not set.	–	–
	n.□□□**9**	n.□□**9**□			–
	n.□□□**A**	n.□□**A**□			–
	n.□□□**B**	n.□□**B**□			–
	n.□□□**C**	n.□□**C**□			–
	n.□□□**D**	n.□□**D**□			–
	n.□□□**E**	n.□□**E**□			–
	n.□□□**F**	n.□□**F**□			–

* When using speed control or force control, the position error monitor signal is not specified.

INFO

The analog monitor output voltage is ±8 V (maximum). The output will be limited to ±8 V even if this value is exceeded in the above calculations.

6

Inspection, Maintenance, and Troubleshooting

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6.1 Troubleshooting

6.1.1 Alarm Display Table

The relation between alarm displays and alarm code outputs is shown in Table 11.1.
If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

- DB STOP: Stops the servomotor immediately using the dynamic brake.
- ZERO-SPEED STOP: Stops the servomotor by setting the speed reference to "0."

Table 6.1 Alarm Displays and Outputs

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.02	Parameter Breakdown	EEPROM data of SERVOPACK is abnormal.	N/A	H	H	H	H
A.03	Main Circuit Encoder Error (Not detected for the SERVOPACKs with the capacity of 7.5 kW or more.)	Detection data for power circuit is abnormal.	Available				
A.04	Parameter Setting Error	• The parameter setting is outside the allowable setting range. • Pn080.0=1 was set though a hall sensor was connected.	N/A				
A.05	Combination Error	• SERVOPACK and servomotor capacities do not match each other. • The linear servomotor and SERVOPACK voltage specifications do not correspond to each other.	Available				
A.08	Linear Scale Pitch Setting Error	The initial value (0 μm) is set for the linear scale pitch (Pn280).	N/A				
A.09	Dividing Ratio Setting Error *1	• A value higher than the motor peak speed that can be obtained from the dividing ratio was set for Pn384. • When connecting the linear servomotor, a value higher than the maximum dividing ratio that can be obtained from the linear servomotor peak speed was set for Pn281.	N/A				
A.0A	Encoder Type Mismatching *1	The mounted serial encoder is not supported by Σ-II series.	N/A				
A.10	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT. Heat sink of SERVOPACK was overheated.	N/A	L	H	H	H
A.30	Regeneration Error Detected	Regenerative transistor or regenerative resistor is faulty.	Available	L	L	H	H
A.32	Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.	Available				
A.33	Main Circuit Power Supply Wiring Error	The power supply to the main circuit does not match the parameter Pn001 setting.	Available				
A.40	Overvoltage *2	Main circuit DC voltage is excessively high.	Available	H	H	L	H
A.41	Undervoltage *2	Main circuit DC voltage is excessively low.	Available				

Table 6.1 Alarm Displays and Outputs (Cont'd)

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.51	Overspeed	• The motor speed is excessively high. • The divided output frequency exceeds 15 MHz.	Available	L	H	L	H
A.55	Linear Servomotor Peak Speed Setting Error*1	When connecting the linear servomotor, a value higher than the linear servomotor peak speed was set for Pn384.	Available				
A.71	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a force largely exceeding ratings.	Available	L	L	L	H
A.72	Overload: Low Load	The motor was operating continuously under a force largely exceeding ratings.	Available				
A.73	Dynamic Brake Overload (Not detected for the SERVOPACKs with the capacity of 50 W to 1.0 kW.)	When the dynamic brake was applied, kinetic energy exceeded the capacity of dynamic brake resistor.	Available				
A.74	Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.	Available				
A.7A	Heat Sink Overheated (Not detected for the SERVOPACKs with the capacity of 50 W to 1.0 kW.)	The heat sink of SERVOPACK overheated.	Available				
A.82	Encoder Checksum Error	The checksum results of encoder memory is abnormal.	N/A	H	H	H	H
A.84	Encoder Data Error	Data in the encoder is abnormal.	N/A				
A.b1	Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.	Available				
A.b2	Reference Force Input Read Error	The A/D converter for reference force input is faulty.	Available				
A.b3	Current Detection Error *1	Current sensor error was detected or linear servomotor line was disconnected.	Available				
A.bF	System Alarm	A system error occurred in the SERVOPACK.	N/A				
A.C1	Servo Overrun Detected	The servomotor ran out of control.	Available	L	H	L	H
A.C2	Phase Faulty Detection Alarm	• The electrical angle at the hall sensor phase-U edge deviated for ±40 degrees or more. • Hall sensor signal error was detected.	N/A				
A.C5	Linear Servomotor Pole Detection Error	The polarity of linear servomotor can not be detected.	−				
A.C9	Encoder Communications Error	Communications between SERVOPACK and encoder is not possible.	N/A				
A.CA	Encoder Parameter Error	Encoder parameters are faulty.	N/A				
A.Cb	Encoder Echoback Error	Contents of communications with encoder is incorrect.	N/A				

Table 6.1 Alarm Displays and Outputs (Cont'd)

Alarm Display	Alarm Name	Meaning	Alarm Reset	Alarm Code Output			Servo Alarm (ALM) Output
				ALO1	ALO2	ALO3	
A.d0	Position Error Pulse Overflow	Position error pulse exceeded parameter (Pn505).	Available	L	L	H	H
A.d3	Exceeded Position Data	Position data is 32-bit or more.	–				
A.F1	Power Line Open Phase	One phase is not connected in the main power supply.	Available	H	L	H	H
A.F6	Servomotor Line Disconnection *1	The power is not supplied to the linear servomotor while the SERVOPACK received a servo ON command.	Available				
CPF00	Digital Operator Transmission Error	Digital operator (JUSP-OP02A-2) fails to communicate with SERVOPACK (e.g., CPU error).	N/A	Not decided			
CPF01			N/A				
A.– –	Not an error	Normal operation status	–	H	H	H	L

* 1. These alarm occur only for the software version 32 or later.
* 2. For the SERVOPACK with a capacity of 7.5 kW:
A.40: Alarm detecting excessively high/low voltage in the main circuit
A.41: Not used

6.1.2 Warning Display

The relation between warning displays and warning code outputs is shown in table 6.2.

Table 6.2 Warning Displays and Outputs

Warning Display	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.90	Excessive Position Deviation *	The position deviation exceeds the value of Pn51E.	H	H	H
A.91	Overload	This warning occurs before the overload alarms (A.71 or A.72) occur. If the warning is ignored and operation continues, an overload alarm may occur.	L	H	H
A.92	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.32) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H

* The warning occurs only for the software version 32 or higher.

Note: Warning code is not output without setting Pn001 = n.1□□□ (Outputs both Alarm Codes and Warning Codes.)

6.1.3 Alarm Display Table when the Application Module is Used

The following special alarms will occur when the SGDH SERVOPACK and an application module are used together. The relation between alarm displays and alarm code outputs is shown in Table 6.3.

Table 6.3 Alarm Displays and Outputs when the SERVOPACK and an Application Module Is Used Together

Alarm Display	Application Module which Detects Alarms				Alarm Name	Meaning	Alarm Code Output			Servo Alarm (ALM) Output
	NS 100	NS 300	NS 500	NS 600			ALO1	ALO2	ALO3	
A.E0	○	○	○	○	No Application Module	No application module installed.	H	L	L	H
A.E1	○	○	○	○	Application Module Time-out	No response from the application module.				
A.E2	○	○	○	○	Watchdog Counter Error of Application Module	WDC error in the application module				
A.E5	○	–	–	–	Watchdog Timer Error	MECHATROLINK synchronization error				
A.E6	○	○	–	–	NS100 Communications Error	MECHATROLINK communications error				
					NS300 Duplicate MAC ID Error	Same node address already exists on the DeviceNet network.				
A.E7	○	○	○	○	Application Module Detection Error	No application module was detected.				
A.E9	–	○	–	–	BUS-OFF Error	Fatal communications error has occurred in DeviceNet communications.				
A.EA	○	○	○	–	SERVOPACK Malfunction	SERVOPACK is defective.				
A.EB	○	○	○	–	SERVOPACK Initial Access Error	Initial processing failed.				
A.EC	○	○	○	–	SERVOPACK WDC Error	SERVOPACK WDC error				
A.ED	○	○	○	–	Command Execution Incomplete	Command was interrupted.				
A.EF	–	–	–	○	Application Module Error	Some kind of alarm occurred in the NS600.				

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK I/F application module
NS300 (JUSP-NS300): Device Net I/F application module
NS500 (JUSP-NS500): PROFIBUS-DP I/F application module
NS600 (JUSP-NS600): INDEXER application module

2. For troubleshooting application module alarms, refer to relevant application module manual.
Manual numbers are described in *Related Manuals* on *page v*.

6.1.4 Warning Display Table when the Application Module is Used

The following special warnings will occur when the SGDH SERVOPACK and an application module are used together. The relation between warning displays and warning code outputs is shown in Table 6.4.

Table 6.4 Warning Displays and Outputs when the SERVOPACK and an Application Module Is Used Together

Warning Display	Application Module which Detects Warnings				Warning Name	Meaning	Warning Code Output			Servo Alarm (ALM) Output
	NS 100	NS 300	NS 500	NS 600			ALO1	ALO2	ALO3	
A.94	○	○	○	−	Data Setting Warning	A value outside the setting range was set using communications.	L	L	H	L
A.95	○	○	○	−	Command Warning	A command not supported in the product specifications was issued. The command reception conditions were not met.	H	L	H	L
A.96	○	○	−	−	Communications Warning	A communications error occurred (once).	L	H	H	L
A.98	−	○	○	−	Main Power OFF	The main power supply is not being supplied.	L	L	L	L
A.9A	−	○	○	−	Not Completed within the Set Time	Positioning was not completed within the set time.	L	H	L	L
A.9F	−	−	−	○	NS600 Error	Some error occurred in the NS600. Check the NS600 Error Display for details.	L	L	L	L

Note: 1. The following types of application modules are available:
NS100 (JUSP-NS100): MECHATROLINK I/F module
NS300 (JUSP-NS300): DeviceNet I/F module
NS500 (JUSP-NS500): PROFIBUS-DP I/F module
NS600 (JUSP-NS600): INDEXER application module

2. For troubleshooting application module alarms, refer to relevant application module manual.
Manual numbers are described in *Related Manuals* on *page v*.

6.1.5 Troubleshooting of Alarm and Warning

When an error occurs in servodrive, an alarm display such as A.□□ and CPF□□ or warning display such as A.9□□ appears on the panel operator. However, the display "A.--" is not an alarm. Refer to the following sections to identify the cause of an alarm and the action to be taken.

Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

(1) Alarm Display and Troubleshooting

Table 6.5 Alarm Display and Troubleshooting

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.02	Parameter Breakdown (The EEPROM data storing the parameter is incorrect.)	Occurred when the control power supply was turned ON.	The control power supply ranged from 30 VAC to 60 VAC.	Correct the power supply, and set Fn005 to initialize the parameter.
			The power supply was turned OFF while changing the parameter setting. The power supply was turned OFF while an alarm was being written.	Set Fn005 to initialize the parameter and input the parameter again.
			The number of times that parameters were written exceeded the limit. For example, the parameter was changed every scan through the host controller.	Replace the SERVOPACK. (Recheck the parameter writing method.)
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
A.03	Main Circuit Encoder Error (Not detected for the SERVOPACK with the capacity of 7.5 kW)	Occurred when the control power supply was turned ON or during operation	The control power supply ranged from 30 VAC to 60 VAC. A SERVOPACK fault occurred.	Correct the power supply. Replace the SERVOPACK.
A.04	Parameter Setting Error (The parameter setting was out of the allowable setting range.)	Occurred when the control power supply was turned ON.	The incorrect parameter was being loaded. (The incorrect value was rejected as an error at the digital operator.)	Set Fn005 to initialize the parameter.
			Pn080.0 = 1 was set though a hall sensor was connected.	Check and correct the hall sensor wiring. Correct the set value of parameter Pn080.0.
			The SERVOPACK EEPROM and the related circuit are faulty.	Replace the SERVOPACK.
A.05	Combination Error (The SERVOPACK and servomotor capacities do not correspond.)	Occurred when the control power supply was turned ON.	The SERVOPACK and servomotor capacities do not correspond to each other. Servomotor capacity / SERVOPACK capacity ≤ 1/4 or servomotor capacity / SERVOPACK capacity ≥ 4	Select the proper combination of SERVOPACK and servomotor capacities.
			The linear servomotor and SERVOPACK voltage specifications do not correspond to each other.	Select the proper combination of SERVOPACK and linear servomotor voltages.
			The parameter that is written in the serial converter unit is incorrect.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.08	Linear Scale Pitch Setting Error	Occurred when the control power supply was turned ON.	The initial value is set for Pn280.	Correct the set value of parameter Pn280.
A.09	Dividing Ratio Setting Error (For the software version 32 or later)	Occurred when the control power supply was turned ON.	A value higher than the motor peak speed that can be obtained from the dividing ratio was set for Pn384.	Change the set value to a value within the allowable peak speed, referring to Un010.
			A value higher than the maximum dividing ratio that can be obtained from the linear servomotor peak speed was set for Pn281.	Change the set value to a value within the allowable dividing ratio, referring to Un010.
A.0A	Encoder Type Mismatching (For the software version 32 or later)	Occurred when the control power supply was turned ON.	The mounted serial encoder is not supported by Σ-II series.	Replace the linear servomotor with the Σ-II series supported model.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.10	Overcurrent (An overcurrent flowed through the IGBT) or Heat Sink Overheated	Occurred when the control power supply was turned ON.	The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
			The connection is faulty between the SERVOPACK board and the thermostat switch.	Replace the SERVOPACK.
			The SERVOPACK board fault occurred.	
		Occurred when the main circuit power supply was turned ON or when an overcurrent occurred while the servomotor was running.	The connection between grounding and U, V, or W is incorrect.	Check and then correct the wiring.
			The grounding line has contact with other terminals.	
			A short circuit occurred between the grounding and U, V, or W of the servomotor cable.	Repair or replace the servomotor main circuit cable.
			A short circuit occurred between phases U, V, and W of the servomotor.	
			The wiring of the regenerative resistor is incorrect.	Check and then correct the wiring.
			A short circuit occurred between the grounding and U, V, or W of the SERVOPACK.	Replace the SERVOPACK.
			A SERVOPACK fault occurred (current feedback circuit, power transistor or board fault).	
			A short circuit occurred between the grounding and U, V, W of the servomotor.	Replace the servomotor.
			A short circuit occurred between phases U, V, and W of the servomotor.	
			The dynamic brake was activated too frequently, so a DB overload alarm occurred.	Replace the SERVOPACK, and reduce the DB operation frequency.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
			The excessive change was given to the position/ speed reference.	Recheck the reference value.
			The overload or regenerative power exceeds the regenerative resistor's capacity.	Reconsider the load and operation conditions.
			The direction or the distance of the SERVOPACK to other devices is incorrect. Heat radiation of the panel or heat around the panel occurred.	The ambient temperature for the SERVOPACK must be 55°C or less.
			A SERVOPACK fan fault occurred.	Replace the SERVOPACK.
			A SERVOPACK fault occurred.	
A.30	Regeneration Error Detected (Detected when the power to the main circuit was turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	An external regenerative resistor is not connected for a servomotor of 7.5 kW.	Connect an external regenerative resistor.
			Pn600 is set to a value other than 0 for a servomotor of 400 W or less, and an external regenerative resistor is not connected.	Connect an external regenerative resistor, or set Pn600 to 0 if an external regenerative resistor is not connected.
			Check for incorrect wiring or a disconnected wire in the regenerative resistor.	Correct the wiring for the external regenerative resistor.
			A SERVOPACK fault occurred, such as regenerative transistor or a voltage sensor fault.	Replace the SERVOPACK.
			The jumper between B2 and B3 is removed for a servomotor of 500 W or more, and 5.0 kW or less.	Correct the wiring.
		Occurred during normal operation.	Check for incorrect wiring and disconnection of the regenerative resistor.	Correct the wiring for the external regenerative resistor.
			The regenerative resistor is disconnected, so the regenerative energy became excessive.	Replace the regenerative resistor or replace the SERVOPACK. Reconsider the load and operation conditions.
			A SERVOPACK fault, such as regenerative transistor and voltage sensor fault, occurred.	Replace the SERVOPACK.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.32	Regenerative Overload (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The power supply voltage is 270 V or more.	Correct the input voltage.
		Occurred during normal operation (large increase of regenerative resistor temperature).	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
			The regenerating state continued.	
		Occurred during normal operation (small increase of regenerative resistor temperature).	The setting of parameter Pn600 is smaller than the external regenerative resistor's capacity.	Correct the set value of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
A.33	Main Circuit Wiring Error (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	In the DC power input mode, AC power is supplied through L1 and L2 or L1, L2, and L3.	For AC power input, Pn001.2=0. For DC power input, Pn001.2=1.
			In the AC power input mode, DC power is supplied through ⊕1 and ⊖ terminals.	
			Pn600 is set to 0 if the regenerative resistance is disconnected.	Set Pn600 to 0.
A.40	Overvoltage (Detected when the SERVOPACK's main circuit DC voltage is 420 V or more.) (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power voltage is too high.	The AC power voltage must be within the specified range.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	Check the AC power voltage (check if there is no excessive voltage change.)	The AC power voltage must be within the specified range.
			The motor speed is high and load mass is excessive, resulting in insufficient regenerative capacity.	Check the load mass and minus load specifications. Reconsider the load and operation conditions.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	The motor speed is high, and the load mass is excessive.	Reconsider the load and operation conditions.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.41	Undervoltage (Detected when the SERVOPACK's main circuit DC voltage is 170 V or less.) (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The AC power supply voltage is low.	The AC power supply voltage must be within the specified range.
			The fuse of the SERVOPACK is blown out.	Replace the SERVOPACK.
			The surge current limit resistor is disconnected, resulting in an abnormal power supply voltage or in an overload of the surge current limit resistor.	Replace the SERVOPACK. Check the power supply voltage, and reduce the number of times that the main circuit is turned ON or OFF.)
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The AC power supply voltage was lowered, and large voltage drop occurred.	The AC power supply voltage must be within the specified range.
			A temporary power failure occurred.	Clear and reset the alarm, and restart the operation.
			The servomotor main circuit cable is short-circuited.	Repair or replace the servomotor main circuit cable.
			The servomotor is short-circuited.	Replace the servomotor.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.51	Overspeed (Detected when the feedback speed is the maximum motor speed)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when servo was ON.	The order of phases U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring is incorrect.	Correct the encoder wiring.
			Malfunction occurred due to noise interference in the encoder wiring.	Take measures against noise for the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor started running or in a high-speed movement.	The order of phases U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring is incorrect.	Correct the encoder wiring.
			Malfunction occurred due to noise interference in the encoder wiring.	Take measures against noise for the encoder wiring.
			The position or speed reference input is too large.	Reduce the reference value.
			The setting of the reference input gain is incorrect.	Correct the reference input gain setting.
			The divided output frequency exceeds 15 MHz.	Correct the setting for dividing output. Decrease the maximum speed.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.55	Linear Servomotor Maximum Speed Setting Error (For the software version 32 or later)	Occurred when the control power supply was turned ON.	When connecting the linear servomotor, a value higher than the linear servomotor peak speed was set for Pn384.	Set a value lower than the maximum speed of the linear servomotor for Pn384.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.71 A.72	Overload A.71: High Load A.72: Low Load	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor did not run by the reference input.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			The starting force exceeds the maximum force.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The polarity detection is not performed properly (when Pn080.0 = 1 is set.)	Correct the settings for the polarity detection related parameter.
			Wrong value in Pn 280	Correct the set value of Pn 280
			Wrong serial converter number	Check the number and motor model
			A linear scale fault occurred	Replace the linear scale
			A SERVOPACK fault occurred	Replace the SERVOPACK
		Occurred during normal operation.	The actual force exceeds the rated force or the starting force largely exceeds the rated force.	Reconsider the load and operation conditions, or reconsider the linear servomotor capacity.
			Temperature in the SERVOPACK panel is high.	Reduce the in-panel temperature to 55° or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.73	Dynamic Brake Overload	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running and in a status other than servo OFF.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running in servo OFF status.	The kinetic energy at a DB stop exceeds the DB resistance capacity.	Reduce the motor speed, Reduce the load mass, or Reduce the number of times of the DB stop operation.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.74	Overload of Surge Current Limit Resistor (Detected when the number of times that the main circuit's power is turned ON or OFF more than 10 times/2 seconds.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during operations other than the turning ON/OFF of the main circuit.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred at the main circuit power supply ON/OFF operation.	The surge current limit resistor operation frequency at the main circuit power supply ON/OF operation exceeds the allowable range.	Reduce the number of times that main circuit's power supply can be turned ON/OFF to 5 times/min. or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.7A	Heat Sink Overheated (Detected when the heat sink temperature exceeds 100 · °C.)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
			The overload alarm has been reset by turning OFF the power too many times.	Change the method to reset the alarm.
		Occurred when the main circuit power supply was turned ON or while the servomotor was running.	The load exceeds the rated load.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The SERVOPACK ambient temperature exceeds 55°C.	The ambient temperature must be 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.82	Encoder Checksum Error (Detected on the encoder side.)	Occurred when the control power supply was turned ON or during an operation.	A fault occurred in the serial converter unit and was detected by the serial converter unit self-diagnosis.	If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.84	Encoder Data Error (Detected on the encoder side.)	Occurred when the control power supply was turned ON.	A malfunction occurred in the serial converter unit.	Turn the control power supply OFF and then ON again. If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A malfunction occurred in the serial converter unit due to external noise.	Correct the wiring around the serial converter unit by separating the serial converter unit cable from the power line, or by checking the grounding and other wiring.)
			A serial converter unit fault occurred.	If this alarm occurs frequently, replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b1	Reference Speed Input Read Error (Detected when the Servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A malfunction occurred in reading section of the speed reference input.	Clear and reset the alarm and restart the operation.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b2	Reference Force Input Read Error (Detected when the servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
			A malfunction occurred in the reading section of the force reference input.	Clear and reset the alarm and restart the operation.
		Occurred during normal operation.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.b3	Current Detection Error (For the software version 32 or later)	Occurred during normal operation.	Current sensor error is detected or servomotor line is disconnected.	Check and correct the servomotor power line, or replace the SERVOPACK.
A.bF	System Alarm (Program error) • Software operation time exceeded • Stack overflow • Micro program error	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	A program is incorrect.	Replace the SERVOPACK. (Contact your Yaskawa representative.)
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.C1	Servo Overrun Detected (Detected when the servo is ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred when the servo was ON or a reference was input.	The order of phase U, V, and W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The encoder wiring in incorrect or the connection is faulty	Correct the encoder wiring
			The polarity detection is not performed properly (When Pn080.0 = 1 is set).	Correct the settings for the polarity detection related parameter.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.C2	Phase Faulty Detection (Occurs when using a hall sensor.)	Occurred when the control power supply was turned ON.	When Pn080.0 = 0 is set though no hall sensor is mounted.	Connect correctly the hall sensor cable to the serial converter unit. Correct the setting of parameter Pn080.0.
			The hall sensor is protruding from the linear servomotor magnetic way.	Reconsider the linear servomotor installation.
			A hall sensor fault occurred.	Replace the linear servomotor coil assembly.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servo is turned ON or during operation.	The linear servomotor coil assembly direction and linear scale direction do not match.	Correct the setting of parameter Pn080.1.
			The hall sensor is protruding from the linear servomotor magnetic way.	Reconsider the linear servomotor installation.
			Noise interference on the hall sensor signals	Take a noise prevention measure for the hall sensor wiring. Connect the case of serial converter unit to FG.
			Wrong value in Pn280	Correct the set value of Pn280. (Pn280: linear pitch scale)
			The linear scale installation does not meet the requirements of the scale specifications.	Reconsider the installation.
			Dust and dirt accumulate on the linear scale.	Remove dust and dirt on the linear scale.
			A linear scale fault occurred.	Replace the linear scale.
A.C5	Polarity Detection Faulty	Occurred during polarity detection.	The polarity detection failed.	Refer to *9.2.3 (d) Troubleshooting for Polarity Detection Errors.*
A.C9	Encoder Communications Error	Occurred when the control power supply was turned ON or during operation.	The serial converter unit wiring and the contact are incorrect.	Correct the serial converter unit wiring.
			Noise interference occurred due to incorrect serial converter unit cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2 (0.0002 in^2).
			Noise interference occurred because the wiring distance for the serial converter unit cable is too long.	The wiring distance must be 20m (65.6 ft) max.
			The noise interference occurred on the signal line because the serial converter unit cable is bent and the sheath is damaged.	Correct the serial converter unit cable layout.
			The serial converter unit cable is bundled with a high-current line or near a high-current line.	Correct the serial converter unit cable layout so that no surge is applied.
			The FG electrical potential varies because of the influence from such machines on the servomotor side as welders.	Ground the machine separately from PG side FG.
			Noise interference occurred on the signal line from the serial converter unit.	Take a measure against noise for the serial converter unit wiring.
			Excessive vibration and shocks were applied to the serial converter unit.	Reduce the machine vibration or mount the serial converter unit securely.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.CA	Encoder Parameter Error	Occurred when the control power supply was turned ON.	A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.Cb	Encoder Echoback Error	Occurred when the control power supply was turned ON or during operation.	The serial converter unit wiring and contact are incorrect.	Correct the serial converter unit wiring.
			Noise interference occurred due to incorrect serial converter unit cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12 mm^2 (0.0002 in^2).
			Noise interference occurred because the wiring distance for the serial converter unit cable is too long.	The wiring distance must be 20m (65.6 ft) max.
			Noise interference occurred on the signal line, because the serial converter unit cable is bent and the sheath is damaged.	Correct the serial converter unit cable layout.
			The serial converter unit cable is bundled with a high-current line or near a high-current line.	Correct the serial converter unit cable layout so that no surge is applied.
			The FG electrical potential varies because of the influence from such machines on the servomotor side as welders.	Ground the machine separately from PG side FG.
			Noise interference occurred on the signal line from the serial converter unit.	Take measures against noise for the serial converter unit wiring.
			Excessive vibration and shocks to the serial converter unit was applied.	Reduce the machine vibration or mount the serial converter unit securely.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
A.d0	Position Error Pulse Overflow (In servo ON status, the position error pulses exceed the overflow level set in the parameter Pn505.)	Occurred when the control power supply was turned ON.	The overflow level (Pn505) is incorrect.	Make the value set in the Pn505 to other than 0.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Occurred at the servomotor high-speed movement.	The contact in the servomotor U, V, and W wirings is faulty.	Correct the servomotor wiring.
				Correct the encoder wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with position reference input.	Wirings of the servomotor U, V, and W are incorrect.	Correct the servomotor wiring.
			A SERVOPACK board fault occurred.	Replace the SERVOPACK.
		Normal movement, but occurred with a long distance reference input.	The SERVOPACK gain adjustment is improper.	Increase the speed loop gain (Pn100) and position loop gain (Pn102).
			The V-REF input voltage and the Pn300 setting are incorrect.	Lower the reference speed to the speed limit value.
			The position reference pulse frequency is too high.	Adjust slowly the position reference pulse frequency.
				Apply the smoothing function.
				Correct the electronic gear ratio.
			Setting of the position error pulse overflow alarm level (Pn505) is incorrect.	Set the parameter Pn505 to proper value.
			The servomotor specifications do not meet the load conditions such as force and mass.	Reconsider and correct the load and servomotor capacity.
A.d3	Exceeded Position Data	Occurred when the control power supply was turned ON or during operation.	Position data is 32-bit or more.	Narrow the movable range of the linear servomotor.
A.F1	Power Line Open Phase (In the main power supply ON status, the voltage stays low for 1 second or more at one of the phases R, S, and T.) (Detected when the main circuit power supply turns ON.)	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the main circuit power supply was turned ON.	The three-phase power supply wiring is incorrect.	Correct the power supply wiring.
			The three-phase power supply is unbalanced.	Balance the power supply by changing phases.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred when the servomotor was running.	The contact in three-phase power supply wiring is faulty.	Correct the power supply wiring.
			Three-phase power supply is unbalanced.	Balance the power supply.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

Table 6.5 Alarm Display and Troubleshooting (Cont'd)

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.F6	Servomotor Line Disconnection (For the software version 32 or later)	Occurred when the servo was turned ON.	The power is not supplied to the linear servomotor while the SERVOPACK received a servo ON command.	Check and then correct the linear servomotor power line wiring, or replace the SERVOPACK.
CPF00	Digital Operator Transmission Error 1 *1	Occurred when the power supply was turned ON with digital operator connected or when connecting digital operator with the power supply was turned ON.	The contact between the digital operator and the SERVOPACK is faulty.	Insert securely the connector, or replace the cable.
			The external noise interference occurred to the digital operator or cable. (The digital operator cable is near noise source.)	Do not lay the cable near noise source.
				Install digital operator far from noise source.
CPF01	Digital Operator Transmission Error 2 *2		A digital operator fault occurred.	Replace the digital operator.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.

* 1. This alarm occurs when the communications is still disabled five seconds after digital operator power supply is ON, or when digital operator communications disabled status stays while an application module is connected.

* 2. This alarm occurs when digital operator received data error occurs consecutively five times, or when the state that digital operator receives no data from SERVOPACK for one second or more occurs consecutively three times.

(2) Warning Display and Troubleshooting

Table 6.6 Warning Display and Troubleshooting

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.90	Excessive Position Error	Occurred during normal operation.	The position error exceeded the setting of parameter Pn51E.	When the position error becomes within the setting of Pn51E, the SERVOPACK will be automatically restored.
A.91	Overload: Warning for the alarms A71 and A72 In either of the following cases: 1. 20% of the overload detection level of A71 2. 20% of the overload detection level of A72.	Occurs when the servo was ON.	Wiring is incorrect and the contact in servomotor wiring is faulty.	Correct the servomotor wiring.
			Wiring is incorrect and the contact in encoder wiring is faulty.	Correct the encoder wiring.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		The servomotor did not run with a reference input.	Servomotor wiring is incorrect and the contact is faulty.	Correct the servomotor wiring.
			Encoder wiring is incorrect and the contact is faulty.	Correct the encoder wiring.
			The starting force exceeds the maximum force.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			The polarity detection is not performed properly. (When Pn080.0 = 1 is set.)	Correct the settings for the polarity detection related parameter.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation.	The effective force exceeds the rated force.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
			Temperature in the SERVOPACK panel is high.	Reduce the in-panel temperature to 55°C or less.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
A.92	Regenerative Overload: Warning for the alarm A320	Occurred when the control power supply was turned ON.	A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred during normal operation (Large increase of regenerative resistor temperature.)	Regenerative energy is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.
			Regenerative status continues.	
		Occurred during normal operation (Small increase of regenerative resistor temperature).	The setting of parameter Pn600 is smaller than the external regenerative resistor capacity.	Correct the setting of parameter Pn600.
			A SERVOPACK fault occurred.	Replace the SERVOPACK.
		Occurred at servomotor deceleration.	Regenerative energy is excessive.	Check the regenerative resistor capacity, or reconsider the load and operation conditions.

6.1.6 Troubleshooting for Malfunction without Alarm Display

The troubleshooting for the malfunctions that causes no alarm display is listed below.
Contact your Yaskawa representative if the problem cannot be solved by the described corrective actions.

Table 6.7 Troubleshooting for Malfunction without Alarm Display

Symptom	Cause	Inspection	Corrective Actions
		■: Turn OFF the servo system before executing operations.	
Linear Servomotor Does Not Start	The control power supply is not ON.	Check voltage between control power supply terminals.	Correct the control power circuit.
	The main circuit power supply is not ON.	Check the voltage between power supply terminals.	Correct the power circuit.
	Wrong wiring or disconnection of I/O signal connector CN1	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Linear servomotor or serial converter unit wiring disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	Speed/position references not input	Check reference input pins.	Input speed/position references correctly.
	Setting for Pn50A to Pn50D "Input Signal Selection" is incorrect.	Check settings of parameters Pn50A to Pn50D.	Correct the settings for Pn50A to Pn50D "Input Signal Selection."
	/S-ON input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Correct the parameter setting and turn ON /S-ON input signal.
	Control method selection is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	Reference pulse mode selection is incorrect.	Check the parameter setting for the reference pulse mode (Pn200.0).	Correct setting of parameter Pn200.0.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Force control: Force reference input is incorrect.	Check T-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the setting of Pn200.0 or the input.
	The error clear counter (CLR) input is turned ON.	Check CLR or /CLR input pins (CN1-14 and -15).	Turn CLR or /CLR input signal OFF.
	The forward run prohibited (P-OT) or reverse run prohibited (N-OT) input signal is turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	The polarity detection is not executed.	Check the parameter Pn080.	Correct the setting of Pn080.
		Check /S-ON or /P-DET input signal.	Turn /S-ON or /P-DET input signal ON.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
Linear Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the servomotor wiring.
	Serial converter unit wiring is incorrect.	Check the serial converter unit wiring.	Correct the serial converter unit wiring.
	Linear scale wiring is incorrect.	Check the linear scale wiring.	Correct the linear scale wiring.
	Linear scale pitch (Pn280) is incorrect.	Check the setting of Pn280.	Correct the setting of Pn280.
	Linear scale counting up direction and linear servomotor coil assembly forward direction are not agreed.	Check the directions.	Change the setting of Pn080.1 (Servomotor Phase Order Selection). Match the linear scale direction and coil assembly direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2) at an arbitrary position is between ±10 degrees.	Correct the settings for the polarity detection related parameter.
Linear Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connection of power lead (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors.

Table 11.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Linear Servomotor Moves Without Reference Input	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input correctly.
	Force control: Force reference input is incorrect.	Check T-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input correctly.
	Speed reference offset is error.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset correctly.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the control mode selection parameter, or the input correctly.
	A SERVOPACK fault occurred.	A SERVOPACK board fault occurred.	Replace the SERVOPACK.
	Linear scale counting up direction and linear servomotor coil assembly forward direction do not agree.	Check the directions.	Change the setting of Pn080.1 (Motor Phase Order Selection). Match the linear scale direction and servomotor direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2) at an arbitrary position is between ±10 degrees.	Correct the polarity detection related parameter settings.
DB (dynamic brake) Does Not Operate	Improper parameter setting	Check the setting of parameter Pn001.0 (Servo OFF or Alarm Stop Mode).	Correct the setting of parameter Pn001.1.
	DB resistor disconnected	Check if excessive mass, motor overspeed, or DB frequently activated occurred.	Replace the SERVOPACK, and reconsider the load.
	DB drive circuit fault	DB circuit parts are faulty.	Replace the SERVOPACK.
Abnormal Noise from Servomotor	Mounting not secured	Check if there are any loosen mounting screws.	Tighten the mounting screws.
	Vibration source on the driven machine	Any foreign matter, damages, or deformation on the machine movable section.	Contact the machine manufacturer.
	Noise interference due to incorrect input signal wire specifications	The specifications of input signal wires must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use the specified input signal wires.
	Noise interference due to long distance of input signal line	The wiring distance must be 3 m (9.84 ft) max. and the impedance a few hundreds ohm max.	Shorten the wiring distance for input signal line to the specified value.
	Noise interference due to incorrect serial converter unit cable specifications	The specifications of encoder cable must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use the specified serial converter unit cable.
	Noise interference due to long serial converter unit cable wiring distance	The wiring distance must be 20 m(65.6 ft) max.	Shorten the serial converter unit cable wiring distance to the specified value.
	Noise due to damaged serial converter unit cable	Check if the serial converter unit cable is not damaged or bent.	Modify the serial converter unit cable layout.
	Excessive noise to the serial converter unit cable	Check if the serial converter unit cable is bundled with high-current line or near the high-current line.	Install a surge suppressor to the serial converter unit cable.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	Check if the machine is correctly grounded.	Ground the machine separately from PG side FG.
	SERVOPACK pulse counting error due to noise	Check if there is noise interference on the signal line from the serial converter unit.	Take measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Vibration from the machine occurred or servomotor installation is incorrect. (Mounting surface accuracy, fixing, or alignment.)	Reduce vibration from the machine, or correct the linear servomotor installation.
	Serial converter unit fault	–	Replace the serial converter unit.
	Linear scale fault	–	Replace the linear scale.

Table 6.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Servomotor Vibrates at about 200 to 400 Hz	Speed loop gain value (Pn100) too high.	Factory setting: Kv=40.0 Hz Refer to *4.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Reduce speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s Refer to *4.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Reduce position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms Refer to *4.3.2 Operating Procedure in Speed Control Mode (Pn000 = n.□□0□)*.	Correct the speed loop integral time constant (Pn101) setting.
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Incorrect mass ratio data setting	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Incorrect machine rigidity setting	Check the setting of Fn001 (Machine Ridigity Setting).	Correct the setting of Fn001 (Machine Ridigity Setting).
High Speed Overshoot on Starting and Stopping.	Speed loop gain value (Pn100) too low	Factory setting: Kv=40.0 Hz Refer to the gain adjustment in User's Manual.	Reduce the speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) too high	Factory setting: Kp=40.0/s Refer to the gain adjustment in User's Manual.	Reduce the position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Factory setting: Ti=20.00 ms Refer to the gain adjustment in User's Manual.	Correct the speed loop integral time constant (Pn101) setting.
	When the autotuning is used: Incorrect mass ratio data	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is not used: Incorrect machine rigidity setting	Check the setting of Fn001 (Machine Ridigity Setting).	Correct the setting of Fn001 (Machine Ridigity Setting).
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	The force reference is saturated.	Check the force reference wave form.	Use the mode switch function.
	The force limit (Pn483, Pn484) is set to the initial value.	Initial value of force limit: Pn483 = 30% Pn484 = 30%	Set a appropriate value for Pn483 and Pn484 (Force Limit).

Table 6.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Overtravel (OT) (Movement over the zone specified by the host controller)	An overtravel signal is output (P-OT (CN1-42) or N-OT (CN1-43)) is at H.	Check if the voltage of input signal external power supply (+24 V) is correct.	Connect to the external +24 V power supply.
		Check if the overtravel limit switch (SW) operates properly.	Correct the overtravel limit SW.
		Check if the overtravel limit switch (SW) is connected correctly.	Correct the overtravel limit SW wiring.
	The overtravel signal does not operate normally (P-OT or N-OT signal sometimes changes).	Check the fluctuation of the input signal external power supply (+24 V) voltage.	Stabilize the external +24 V power supply voltage.
		Check if the overtravel limit switch (SW) activate correctly.	Adjust the overtravel limit SW so that it operates correctly.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loosen screws.)	Correct the overtravel limit SW wiring.
	Incorrect P-OT/N-OT signal selection	Check the P-OT signal selection (Pn50A.3).	Correct the setting of P-OT signal selection (Pn50A.3).
		Check the N-OT signal selection (Pn50B.0).	Correct the setting of N-OT signal selection (Pn50B.0).
	Incorrect servomotor stop method selection	Check if "coast to stop" in servo OFF status is selected.	Check Pn001.0 and Pn001.1.
		Check if "coast to stop" in force control mode is selected.	Check Pn001.0 and Pn001.1.
	Improper overtravel position setting	The distance to the position of OT (overtravel) is too short considering the coasting distance.	Correct the OT position.
	Noise interference due to improper serial converter unit cable specifications	The serial converter unit cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use serial converter unit cable with the specified specifications.
	Noise interference because the serial converter unit cable distance is too long.	The wiring distance must be 20 m (65.6 ft) max.	The serial converter unit cable distance must be within the specified range.
	Noise influence due to damaged serial converter unit cable	Check if the serial converter unit cable is bent or its sheath is damaged.	Correct the serial converter unit cable layout.
	Excessive noise interference to serial converter unit cable	Check if the serial converter unit cable is bundled with a high-current line or near high-current line.	Change the serial converter unit cable layout so that no surge is applied.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	Check if the machine is correctly grounded.	Ground the machine separately from PG side FG.
	SERVOPACK pulse count error due to noise	Check if the signal line from the serial converter unit is influenced by noise.	Take a measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Machine vibration occurred or servomotor mounting such as mounting surface precision, fixing, alignment is incorrect.	Reduce the machine vibration or mount the servomotor securely.
	Serial converter unit fault	–	Replace the serial converter unit.
	SERVOPACK fault	–	Replace the SERVOPACK.
Position error (without alarm)	Noise interference due to improper input signal cable specifications	The input signal cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 (0.0002 in^2) min. and tinned annealed copper twisted wire.	Use input signal cable with the specified specifications.
	Noise interference because the input signal cable distance is too long.	The wiring distance must be 3 m (9.84 ft) max. and the impedance several hundreds ohm max.	The input signal cable distance must be within the specified range.
	Reference pulse frequency is too high.	Check Un00C (Reference Pulse Counter.)	Reduce the reference pulse frequency to a value within the specification.
	Serial converter unit fault (pulse count does not change)	–	Replace the serial converter unit.

Table 6.7 Troubleshooting for Malfunction without Alarm Display (Cont'd)

Symptom	Cause	Inspection	Corrective Actions
		: Turn OFF the servo system before executing operations.	
Servomotor Overheated	Ambient temperature too high	Measure servomotor ambient temperature.	Reduce ambient temperature to 40°C (104 °F) max.
	Servomotor surface dirty	Check visually.	Clean dust and oil from servomotor surface.
	Overloaded	Run under no load.	Reconsider load and operation conditions or replace with larger capacity servomotor.

6.2 Inspection and Maintenance

6.2.1 Linear Servomotor Inspection

⚠ CAUTION

- Do not disassemble the linear servomotor.
  Failure to observe this caution may result in electric shock or injury.

Simple, daily inspection is sufficient. The inspection and maintenance frequencies in Table 6.8 are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

If disassembly of the linear servomotor is required because of the linear servomotor failure, contact your Yaskawa representative.

Table 6.8 Linear Servomotor Inspections

Item	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen from safe position.	Levels higher than normal?
Exterior	According to degree of contamination	Clean with cloth or compressed air.	Use alcohol solvent.
Insulation Resistance Measurement	At least once a year	Disconnect SERVOPACK and test insulation resistance at 500 V. Must exceed 10 MΩ .*	Contact your Yaskawa representative if the insulation resistance is below 10 MΩ. Do not perform insulation resistance measurement and withstand voltage test for the sensors.
GAP between Coil Assembly and Magnetic Way	At least once a year	Disconnect the linear servomotor from the SERVOPACK, and then check the gap.	The GAP dimension stays unchanged from its initial value.
Overhaul	At least once every 5 years	Contact your Yaskawa representative.	The user should not disassemble and clean the servomotor.

* Measure across the servomotor FG and the phase-U, phase-V, or phase-W power line.

6.2.2 SERVOPACK Inspection

For inspection and maintenance of the SERVOPACK, follow the inspection procedures in Table 6.9 at least once every year. Other routine inspections are not required.

Table 6.9 SERVOPACK Inspections

Item	Frequency	Procedure	Comments
Clean Interior and Circuit Boards	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with cloth or compressed air.
Loose Screws		Check for loose terminal block and connector screws.	Tighten any loose screws.
Defective Parts in Unit or on Circuit Boards		Check for discoloration, damage, or discontinuities due to heating.	Contact your Yaskawa representative.

6.2.3 SERVOPACK's Parts Replacement Schedule

The following electric or electronic parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated.

The parameters of any SERVOPACKs overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.

Table 6.10 Periodical Part Replacement

Part	Standard Replacement Period	Replacement Method	Operating Conditions
Cooling Fan	4 to 5 years	Replace with new part.	• Ambient Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.
Smoothing Capacitor	7 to 8 years	Test. Replace with new part if necessary.	
Relays	–	Test. Replace if necessary.	
Fuses	10 years	Replace with new part.	
Aluminum Electrolytic Capacitor on Circuit Board	5 years	Test. Replace with new circuit board if necessary.	

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Appendix

7.1 Linear Servomotor Capacity Selection Examples - - - - - - - 7-2

7.2 Calculating the Required Capacity of Regenerative Resistors - 7-4

7.2.1 Simple Calculation - 7-4

7.2.2 Calculating the Regenerative Energy - 7-6

7.3 Connection to Host Controller - 7-13

7.3.1 Example of Connection to MP920 4-axes Analog Module SVA-01 7-13

7.3.2 Example of Connection to CP-9200SH Servo Controller Module SVA (SERVOPACK in Speed Control Mode) - - - - - - - - - - - - - - - - - - 7-14

7.3.3 Example of Connection to MEMOCON GL120/130 Series Motion Module MC20 - 7-15

7.3.4 Example of Connection to MEMOCON GL60/70 Series Positioning Module B2813 (SERVOPACK in Position Control Mode) - - - - - - - - 7-16

7.3.5 Example of Connection to OMRON's Motion Control Unit - - - - - - - 7-17

7.3.6 Example of Connection to OMRON's Position Control Unit - - - - - 7-18

7.3.7 Example of Connection to OMRON's Position Control Unit C500-NC221 (SERVOPACK in Speed Control Mode) - - - - - - - - - - 7-19

7.3.8 Example of Connection to OMRON's Position Control Unit C500-NC112 (SERVOPACK in Position Control Mode) - - - - - - - - - 7-20

7.3.9 Example of Connection to Mitsubishi's AD72 Positioning Unit (SERVOPACK in Speed Control Mode) - 7-21

7.3.10 Example of Connection to Mitsubishi's AD75 Positioning Unit (SERVOPACK in Position Control Mode) - - - - - - - - - - - - - - - - - - 7-22

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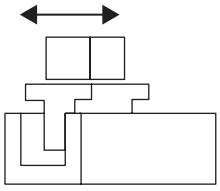
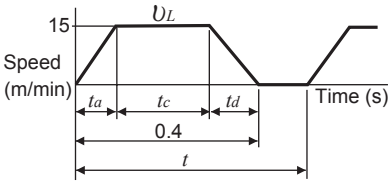
7.1 Linear Servomotor Capacity Selection Examples



- Load speed: v_L =120 m/min
- Workpiece mass: W_W = 1 kg
- Table mass: W_T = 2 kg
- Feeding times: n = 120 times/min
- Feeding distance: ℓ = 0.76 m
- Feeding time: t_m = 0.4 s max.
- Acceleration time: t_a = 0.02 s
- Friction coefficiency: μ = 0.2

(1) Speed Diagram



$$t = \frac{60}{n} = \frac{60}{120} = 0.5 \text{ (s)}$$

where $t_a = t_d$

$t_c = 0.4 - (0.02 \times 2) = 0.36$ (s)

(2) Force Under Constant Load

$$F_L = 9.8 \cdot \mu \cdot (W_W + W_T) = 9.8 \times 0.2 \times (1+2) = 5.88 \text{ (N)}$$

(3) Force at Load Acceleration

$$F_P = (W_M + W_T) \cdot \frac{v_L}{60 \cdot t_a} + F_L = (1+2) \times \frac{120}{60 \times 0.02} + 5.88 = 305.88 \text{ (N)}$$

(4) Linear Servomotor Provisional Selection

(a) Selecting Conditions

- $F_P \leq$ Linear servomotor maximum force

The following models satisfy the conditions.

- SGLGW-60A253BP linear servomotor coil assembly
- SGDH-04AE SERVOPACK

(b) Specifications of the Provisionally Selected Linear Servomotor and SERVOPACK

- Rated output: 400 (W)
- Rated speed: 1500 (mm/s)
- Rated force: 147 (N)
- Instantaneous peak force: 440 (N)
- Linear servomotor coil assembly mass: W_M = 0.82 （kg）

(5) Verification on the Provisionally Selected Linear Servomotor

- Force under constant load

$$F_L = 9.8\ \mu\ (W_W + W_T + W_M) = 9.8 \times 0.2 \times (1 + 2 + 0.82) = 7.5\ (\mathrm{N})$$

- Force at load acceleration

$$F_P = \frac{\upsilon_L\ (W_W + W_T + W_M)}{60 t_a} + F_L = \frac{120 \times (1 + 2 + 0.92)}{60 \times 0.02} + 7.5$$

$= 389.5\ (\mathrm{N}) <$ Instantaneous peak force $\times 0.9$ ⋯Satisfactory

- Force at load deceleration

$$F_S = \frac{\upsilon_L\ (W_W + W_T + W_M)}{60 t_a} - F_L = \frac{120 \times (1 + 2 + 0.82)}{60 \times 0.02} - 7.$$

$= 374.5\ (\mathrm{N}) <$ Instantaneous peak force $\times 0.9$ ⋯Satisfactory

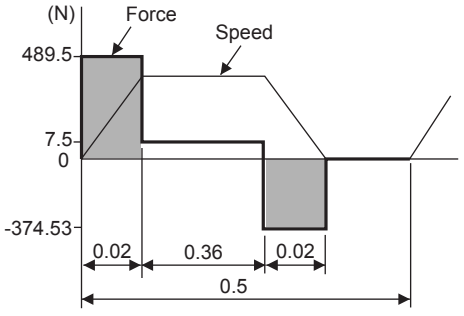
- Effective force

$$Frms = \sqrt{\frac{F_P{}^2 \cdot t_a + F_L{}^2 \cdot t_c + F_S{}^2 \cdot t_d}{t}} = \sqrt{\frac{(389.5)^2 \times 0.02 + (7.5)^2 \times 0.36 + (374.5)^2 \times 0.02}{0.5}}$$

$\fallingdotseq 108.3\ (\mathrm{N}) <$ Rated force $\times 0.9$ ⋯Satisfactory

(6) Result

The provisionally selected linear servomotor and SERVOPACK are confirmed to be applicable.
The force diagram is shown below.



7.2 Calculating the Required Capacity of Regenerative Resistors

7.2.1 Simple Calculation

When driving a linear servomotor with the horizontal axis, check the external regenerative resistor requirements using the calculation method shown below.

(1) SERVOPACKs with Capacities of 400 W or Less

SERVOPACKs with capacities of 400 W or less do not have built-in regenerative resistors. The energy that can be charged with capacitors is shown in the following table. If the kinetic energy in the linear servomotor exceeds these values, then connect an external regenerative resistor.

Voltage	Applicable SERVOPACKs	Regenerative Energy that Can be Processed (joules)	Remarks
200 V	SGDH -A5AE	18.5	Value when main circuit input voltage is 200 VAC
	SGDH-01AE to -04AE	37.1	

Calculate the kinetic energy (E_S) in the linear servomotor from the following equation.

$E_S = MV_M{}^2 / 2$

M : Load mass (kg)

V_M : Speed used by linear servomotor (m/s)

(2) SERVOPACKs with Capacities of 500 W to 5.0 kW

SERVOPACKs with capacities of 500 W to 5.0 kW have built-in regenerative resistors. The allowable frequencies for just the servomotor in acceleration and deceleration operation, during the motor speed cycle from 0 (m/s) to the maximum speed to 0, are summarized in the following table.

Convert the data into the values obtained with actual rotation speed and load mass to determine whether an external regenerative resistor is needed.

Linear Servomotor Model		Allowable Frequencies in Regenerative Mode (times/min.)	Load Condition
SGLGW-	60A365B	6	× 15
SGLFW-	35A230A	11	× 3
	50A200A	2	
	50A380A	1	
	1ZA200A	1	
	1ZA380A	1	
SGLTW-	20A170A	10	× 3
	20A320A	2	
	20A460A	1	
	35A170A	4	
	35A320A	1	
	35A460A	1	
	40A400A	2	Linear servomotor only
	40A600A	1	
	80A400A	3	

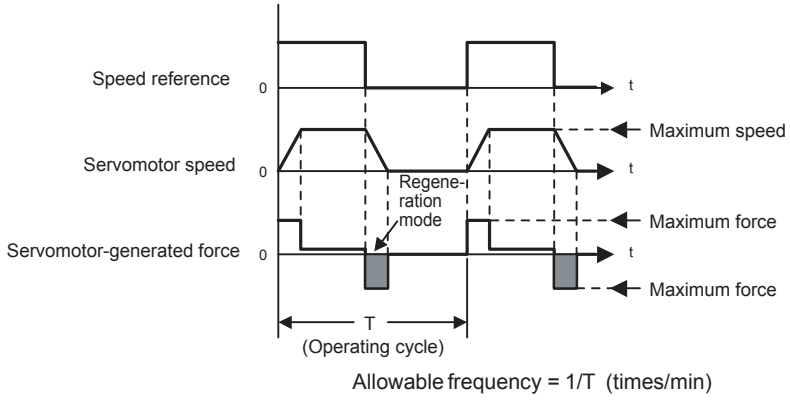


Fig. 7.1 Operating Conditions for Allowable Regenerative Frequency Calculation

Use the following equation to calculate the allowable frequency for regenerative mode operation.

$$\text{Allowable frequency} = \frac{\text{Allowable frequency in regenerative mode (times)}}{n} \times \left(\frac{\text{Peak speed}}{\text{Used speed}} \right)^2 \text{(times/min)}$$

- n : For SGLGW, $n = \left(\frac{W}{W_M} \right) / 15$

  For SGLTW and SGLFW, (excluding SGLTW-40 and -80) $n = \left(\frac{W}{W_M} \right) / 3$

  For SGLTW-40 and -80, $n = \frac{W}{W_M}$

- W_M : Linear servomotor coil assembly mass
- W : Load mass (including coil assembly)

(3) SERVOPACKs with Capacity of 7.5 kW

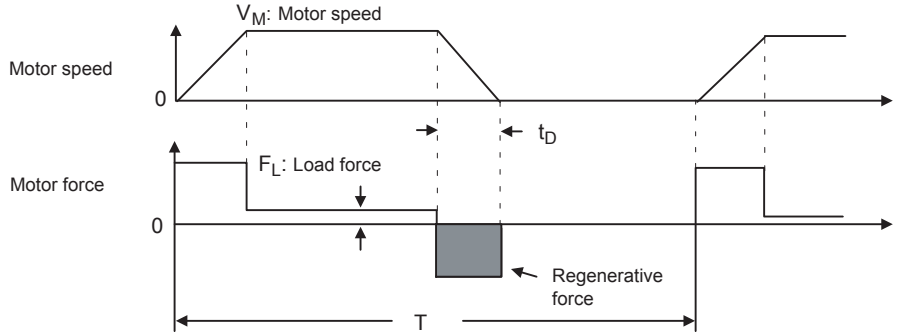
SERVOPACKs with capacity of 7.5 kW do not have built-in regenerative resistors. The following table shows the allowable regenerative frequencies when the JUSP-RA05 regenerative resistor is used together with an applicable SERVOPACK.

The linear servomotor driven conditions and the conversion equation of the allowable regenerative frequencies to the speed and load mass are the same as *(2) SERVOPACKs with Capacities of 500 W to 5.0 kW*.

Linear Servomotor Model	Allowable Frequencies in Regenerative Mode (times/min.)	Load Condition
SGLTW-80A600A	17	Linear servomotor only

7.2.2 Calculating the Regenerative Energy

This section shows the procedure for calculating the regenerative resistor capacity when acceleration and deceleration operation is as shown in the following diagram.



(1) Calculation Procedure

The procedure for calculating the regenerative capacity is as follows:

Step	Item	Symbol	Equation
1	Calculate the kinetic energy of the linear servomotor.	E_S	$E_S = MV_M^2/2$
2	Calculate the energy consumed by friction loss during the deceleration period.	E_L	$E_L = V_M F_L t_D/2$
3	Calculate the energy lost from linear servomotor winding resistance.	E_M	(Value calculated from "(2) Servomotor Winding Resistance Loss" diagrams) × t_D
4	Calculate the SERVOPACK energy that can be absorbed.	E_C	Calculate from "(3) SERVOPACK's Absorbable Energy" diagrams.
5	Calculate the energy consumed by the regenerative resistor.	E_K	$E_K = E_S - (E_L+E_M+E_C)$
6	Calculate the required regenerative resistor capacity (W).	W_K	$W_K = E_K/(0.2 \times T)$

Note: 1. The "0.2" in the equation for calculating W_K is the value for when the regenerative resistor's utilized load ratio is 20%.

2. The units for the various symbols are as follows:

Symbol	Units	Meanings
E_S	J	Kinetic energy of linear servomotor
E_L		Energy consumed by friction loss during the deceleration period
E_M		Energy consumed by linear servomotor winding resistance loss
E_C		Energy that can be absorbed by SERVOPACK
E_K		Energy consumed by regenerative resistor
W_K	W	Required capacity of regenerative resistor
$M(=M_M+M_L)$	kg	Load mass including linear servomotor
V_M	m/s	Linear servomotor movement speed
F_L	N	Load force
t_D	sec	Period to decelerate to a stop
T		Repeated operation cycle of linear servomotor

If the above calculation determines that the amount of regenerative power (Wk) processed by the built-in resistor is not exceeded, then an external regenerative resistor is not required.

If the amount of regenerative power that can be processed by the built-in resistor is exceeded, then install an external regenerative resistor for the capacity obtained from the above calculation.

If the energy consumed by load loss (in step 2 above) is unknown, then perform the calculation using $E_L = 0$.

When the operation period in regeneration mode is continuous, add the following items to the above calculation procedure in order to find the required capacity (W) for the regenerative resistor.

- Energy for continuous regeneration mode operation period: E_G (joules)

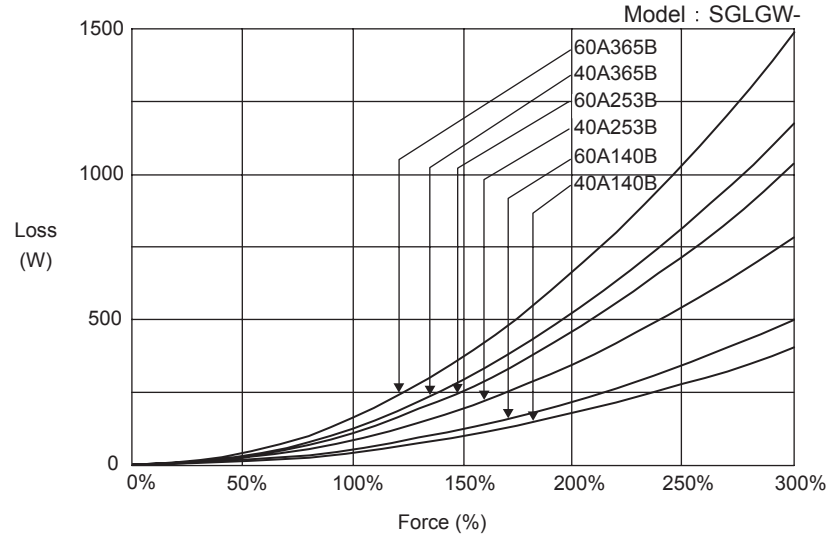
Here, $E_G = V_{MG}T_Gt_G$

- V_{MG}: Linear servomotor speed (m/s) for same operation period as above
- T_G: Linear servomotor's generated force (N) in continuous regenerative mode operation period
- t_G: Same operation periods as above
- Energy consumed by a regenerative resistor: $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor: $W_K = E_K / (0.2 \times T)$

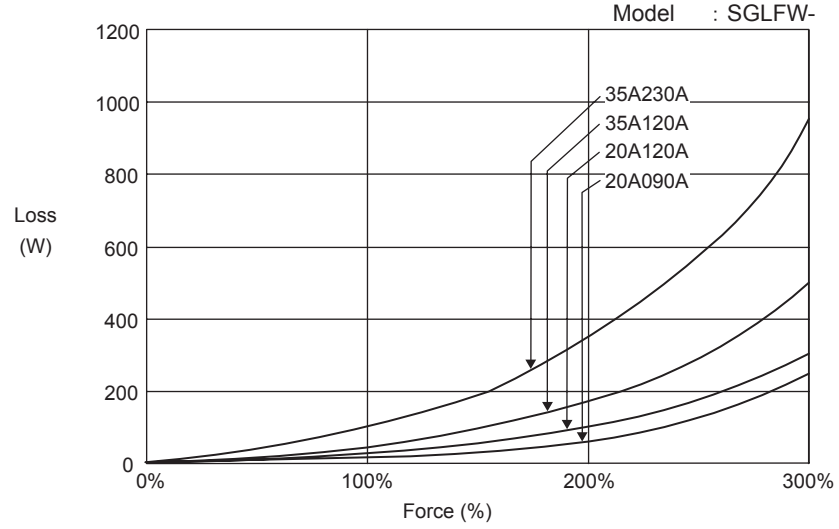
(2) Servomotor Winding Resistance Loss

The following diagrams show the relationship, for each servomotor, between the servomotor's generated force and the winding resistance loss.

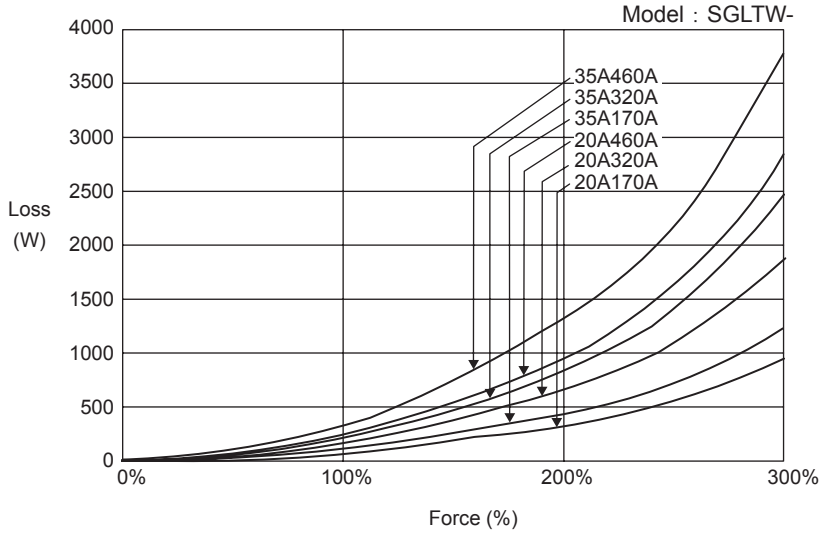
(a) SGLGW Linear Servomotors



(b) SGLFW Linear Servomotors



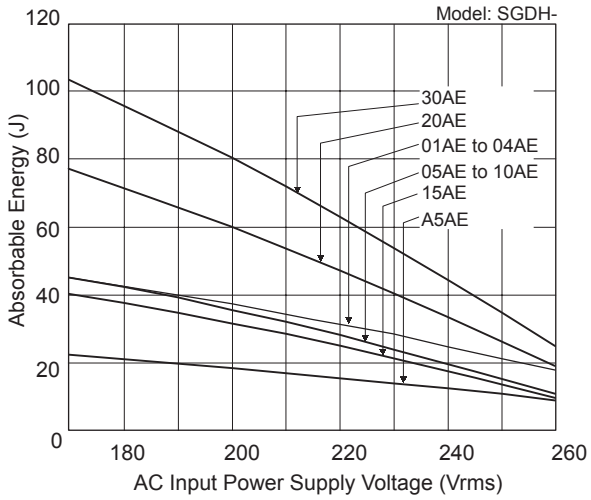
(c) SGLTW Linear Servomotors

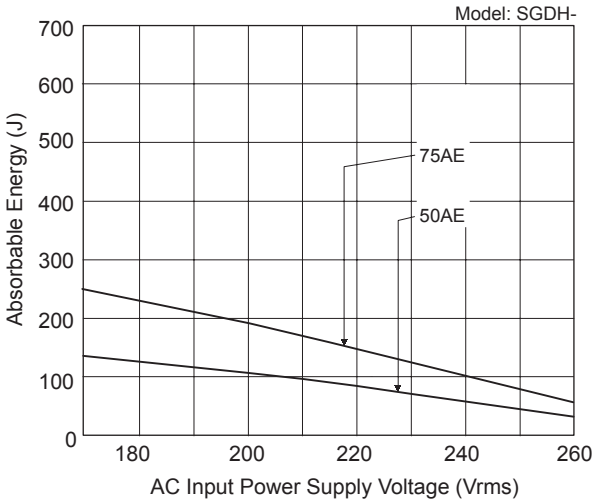


(3) SERVOPACK's Absorbable Energy

The following diagrams show the relationship between the SERVOPACK's input power supply voltage and its absorbable energy.

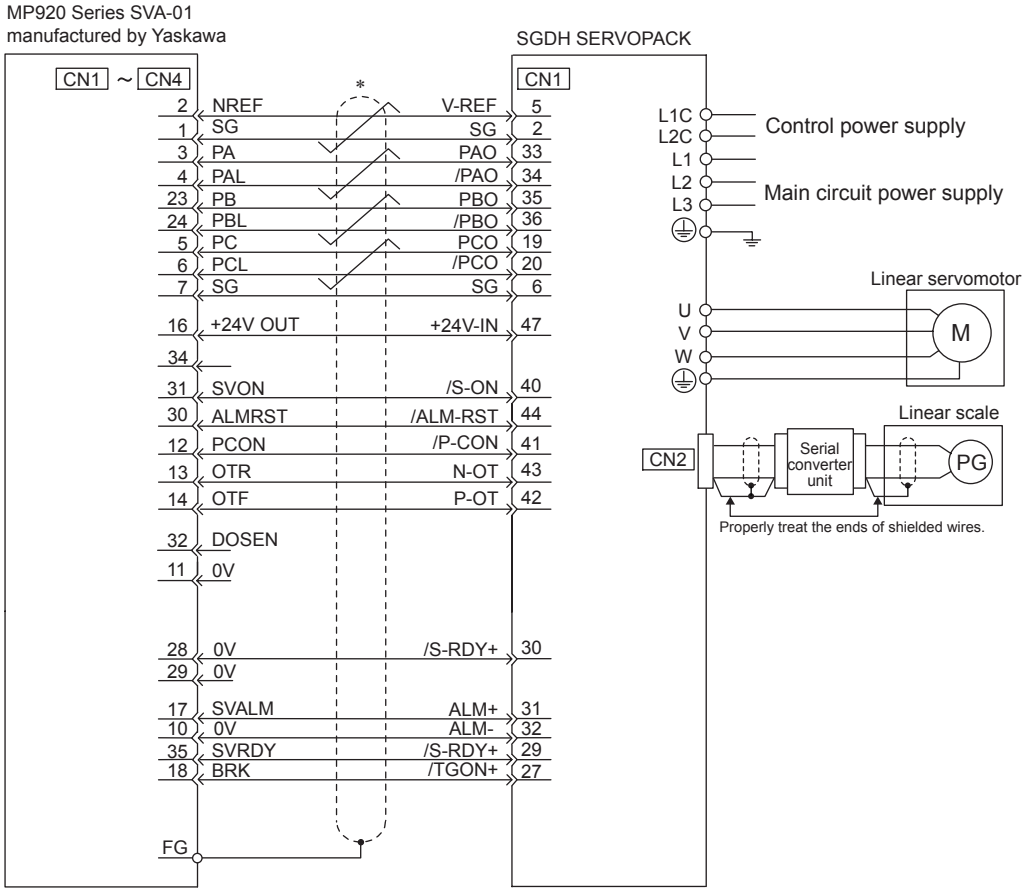
(a) 200-V SERVOPACKs





7.3 Connection to Host Controller

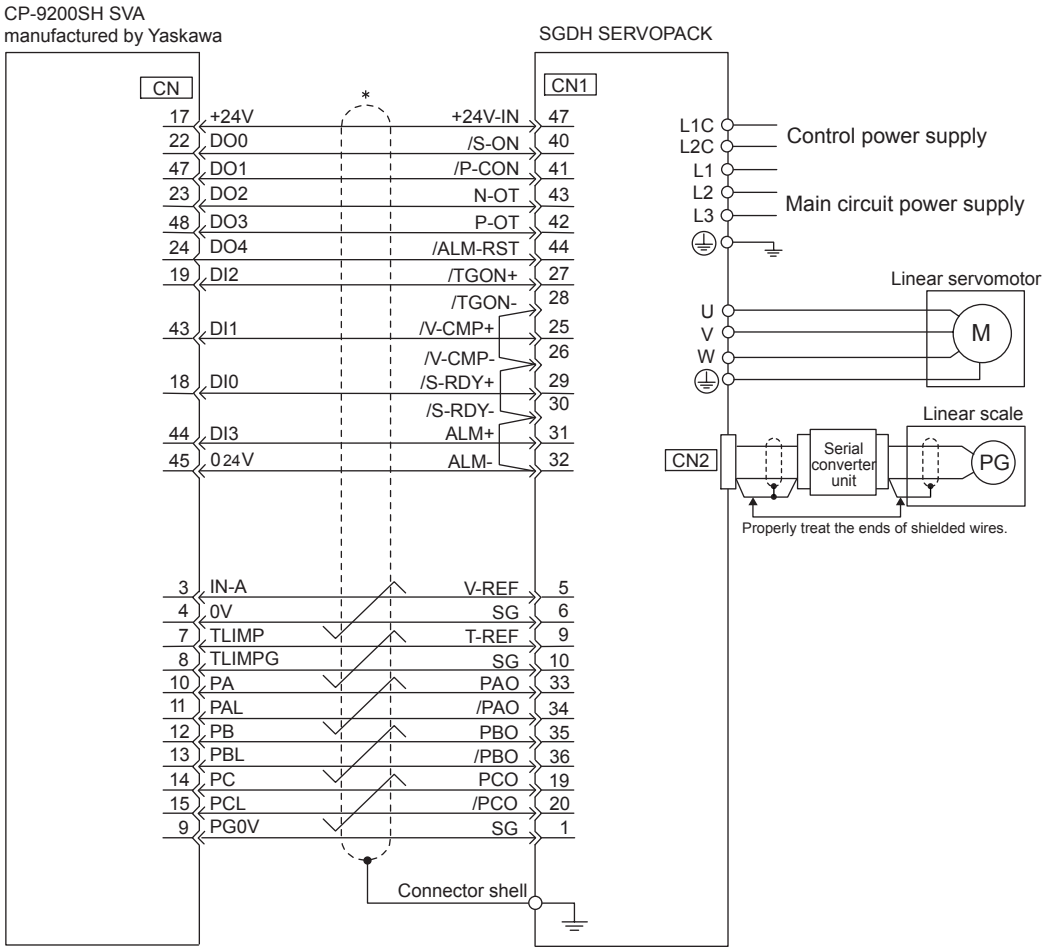
7.3.1 Example of Connection to MP920 4-axes Analog Module SVA-01



* represents twisted-pair wires.

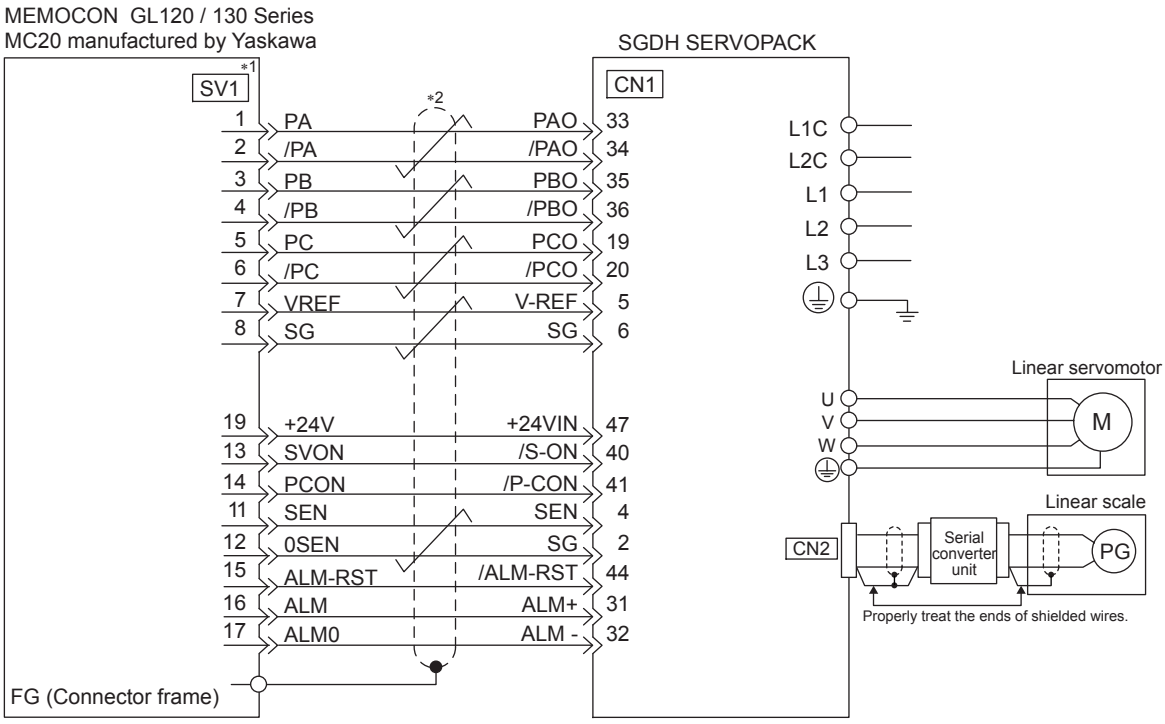
Note: Connection cables (model: JEPMC-W6050-□□) to connect the SERVOPACK to the MP920 are provided by Yaskawa. For details, refer to *Machine Controller MP920 User's Manual design and maintenance (manual no. SIEZ-C887-2.1)*.

7.3.2 Example of Connection to CP-9200SH Servo Controller Module SVA (SERVOPACK in Speed Control Mode)



* represents twisted-pair wires.

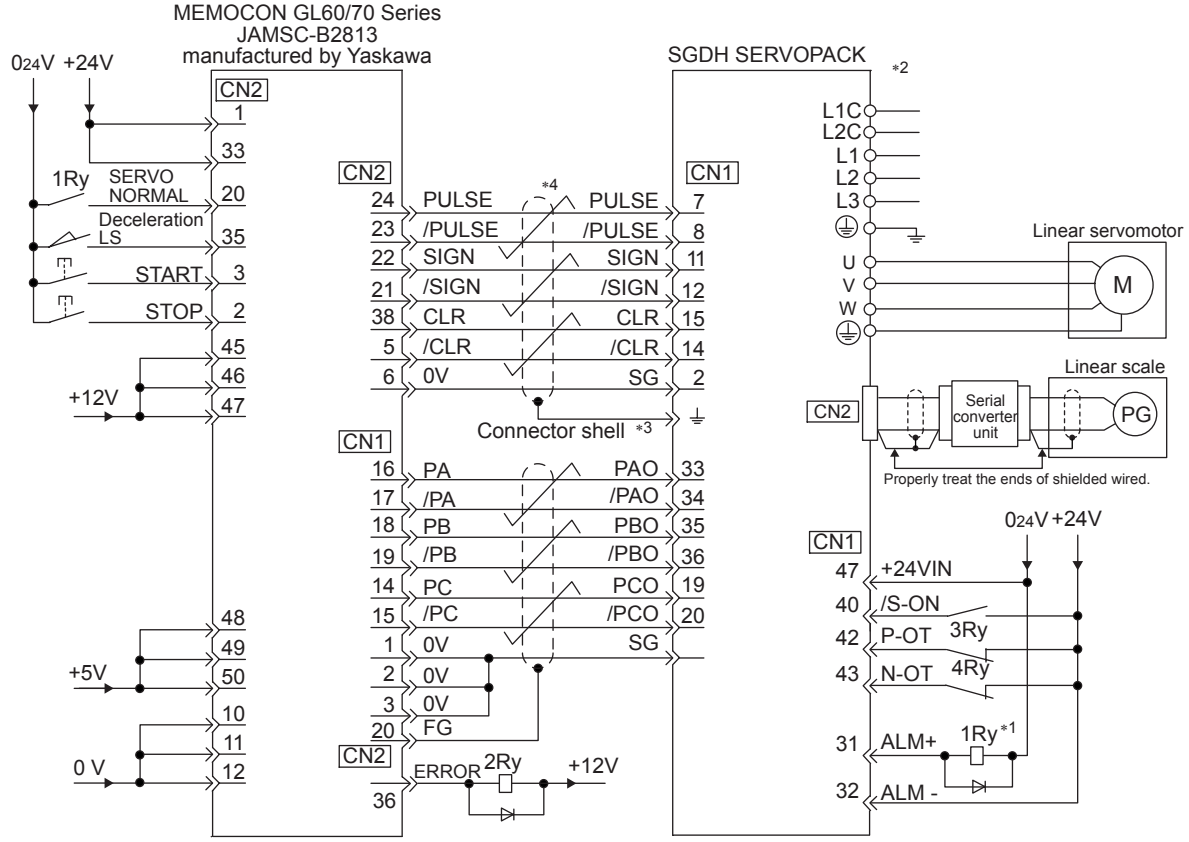
7.3.3 Example of Connection to MEMOCON GL120/130 Series Motion Module MC20



* 1. Pin numbers are the same for SV2 to SV4.

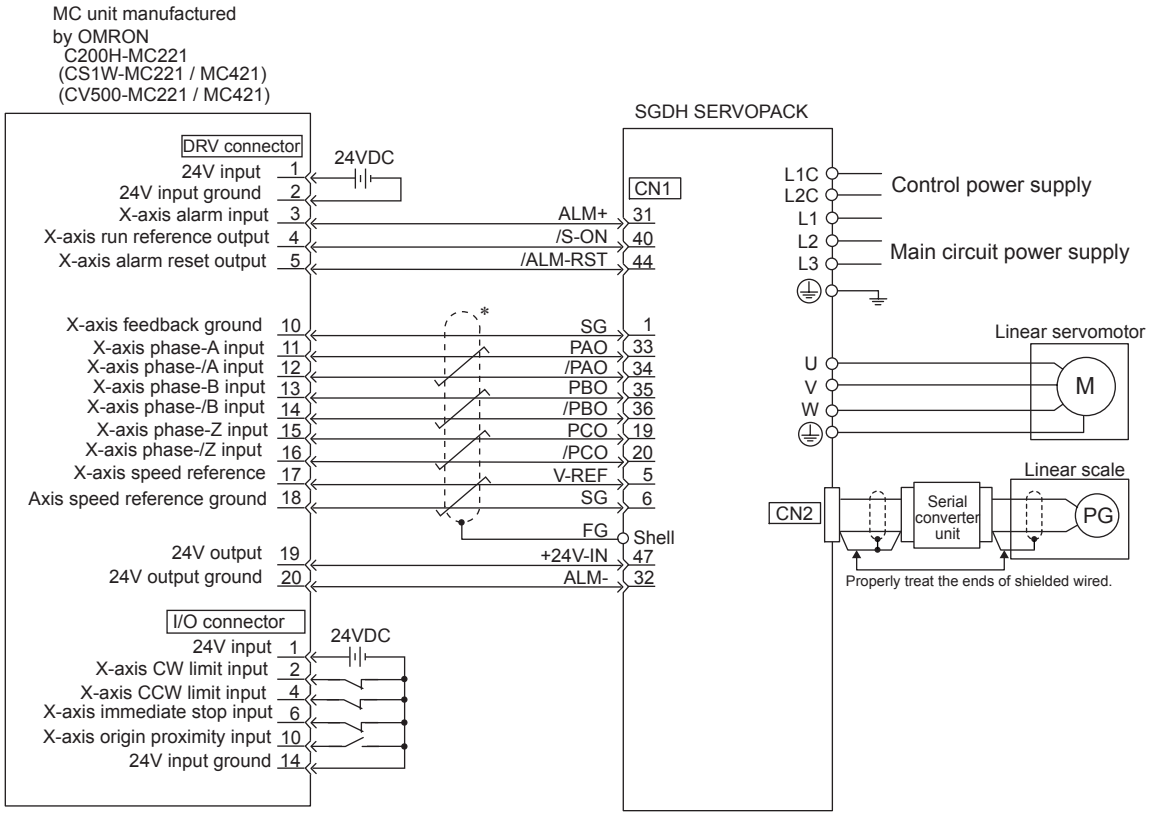
* 2. represents twisted-pair wires.

7.3.4 Example of Connection to MEMOCON GL60/70 Series Positioning Module B2813 (SERVOPACK in Position Control Mode)



* 1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.
* 2. Set parameter Pn200.0 to 1.
* 3. Connect the shield wire to the connector shell.
* 4. represents twisted-pair wires.

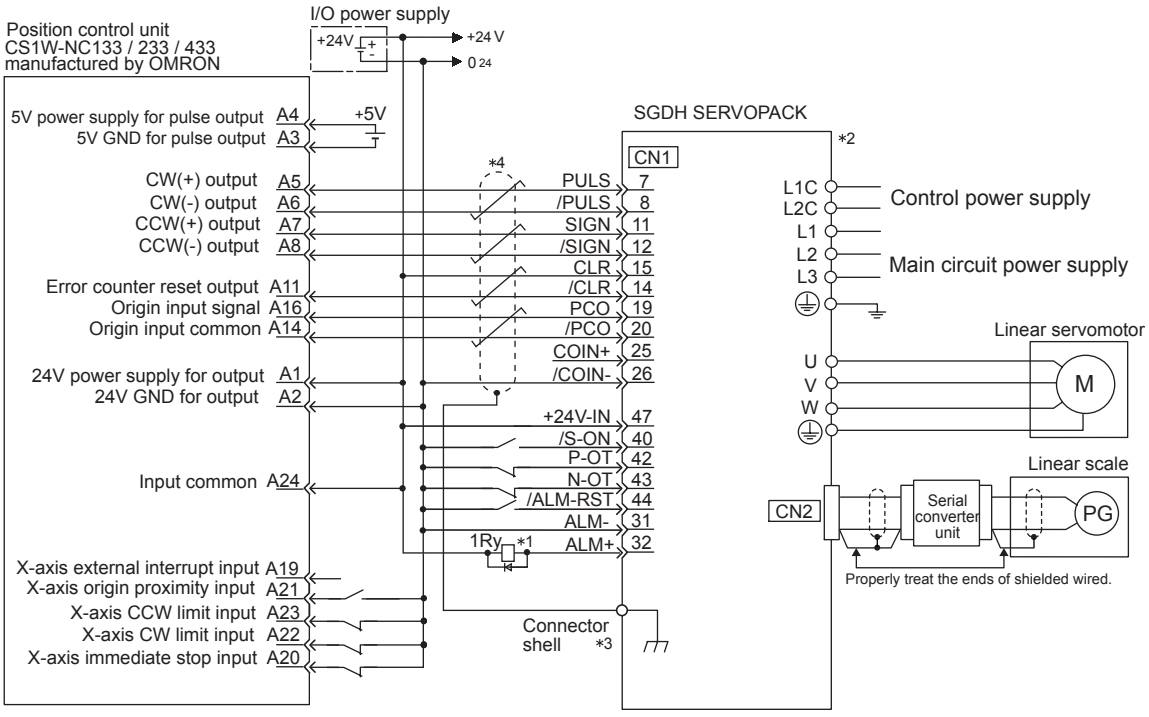
7.3.5 Example of Connection to OMRON's Motion Control Unit



* represents twisted-pair wires.

Note: 1. Only signals applicable to OMRON's MC unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.
2. The main circuit power supply is a three-phase 200 VAC SERVOPACK input in the example. The power supply and wiring must be in accordance with the power supply specifications of the SERVOPACK to be used.
3. Note that incorrect signal connection will cause damage to the MC unit and SERVOPACK.
4. Open the signal lines not to be used.
5. The above connection diagram shows only X-axis connection. When using another axes, make connection to the SERVOPACK in the same way.
6. The normally closed (N.C.) input terminals not to be used at the motion control unit I/O connector section must be short-circuited at the connector.
7. Make the setting so that the servo can be turned ON/OFF by the /S-ON signal.

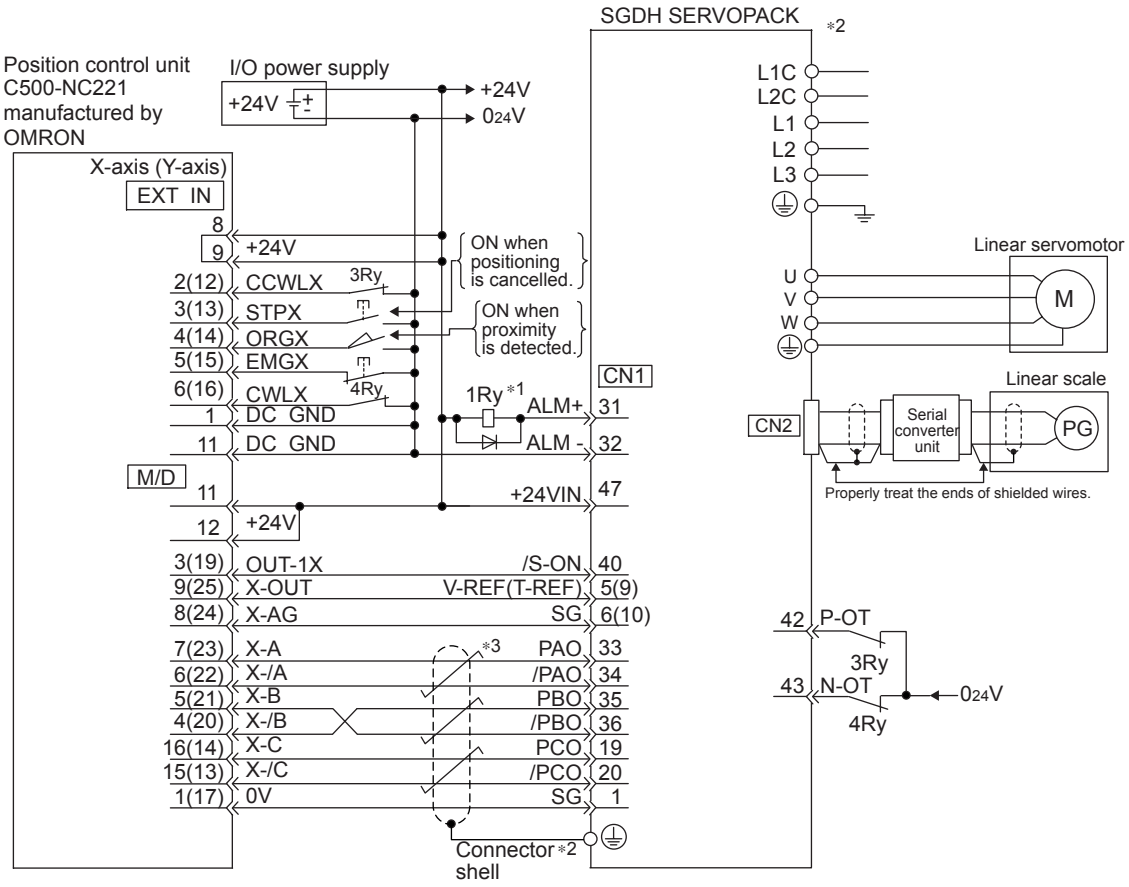
7.3.6 Example of Connection to OMRON's Position Control Unit



* 1. The ALM signal is output for about two seconds after the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.
* 2. Set parameter Pn200.0 to 1.
* 3. Connect the shield wire to the connector shell.
* 4. represents twisted-pair wires.

Note: Only signals applicable to OMRON's MC unit (positioning unit) and Yaskawa's SGDS SERVOPACK are shown in the diagram.

7.3.7 Example of Connection to OMRON's Position Control Unit C500-NC221 (SERVOPACK in Speed Control Mode)



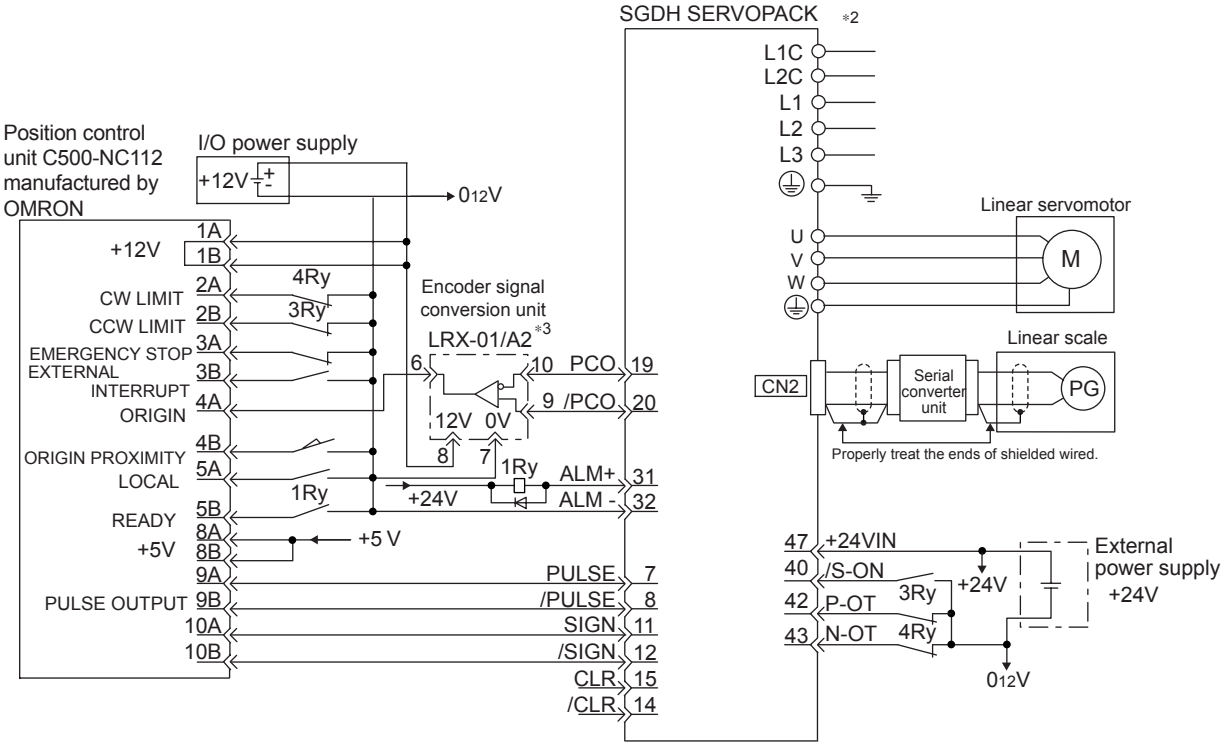
* 1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.

* 2. Connect the I/O cable's shield wire to the connector shell.

* 3. represents twisted-pair wires.

Note: Only signals applicable to OMRON's C500-NC221 position control unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

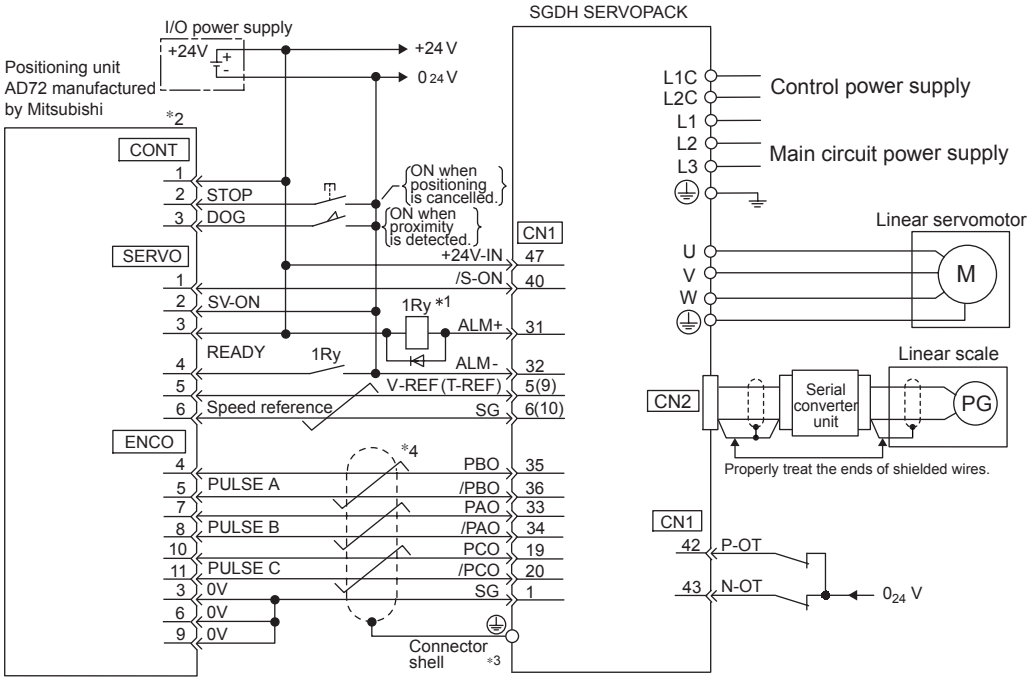
7.3.8 Example of Connection to OMRON's Position Control Unit C500-NC112 (SERVOPACK in Position Control Mode)



* 1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.
* 2. Set parameter Pn200.0 to 1.
* 3. Manufactured by Yaskawa Controls Co., Ltd.

Note: Only signals applicable to OMRON's C500-NC112 position control unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

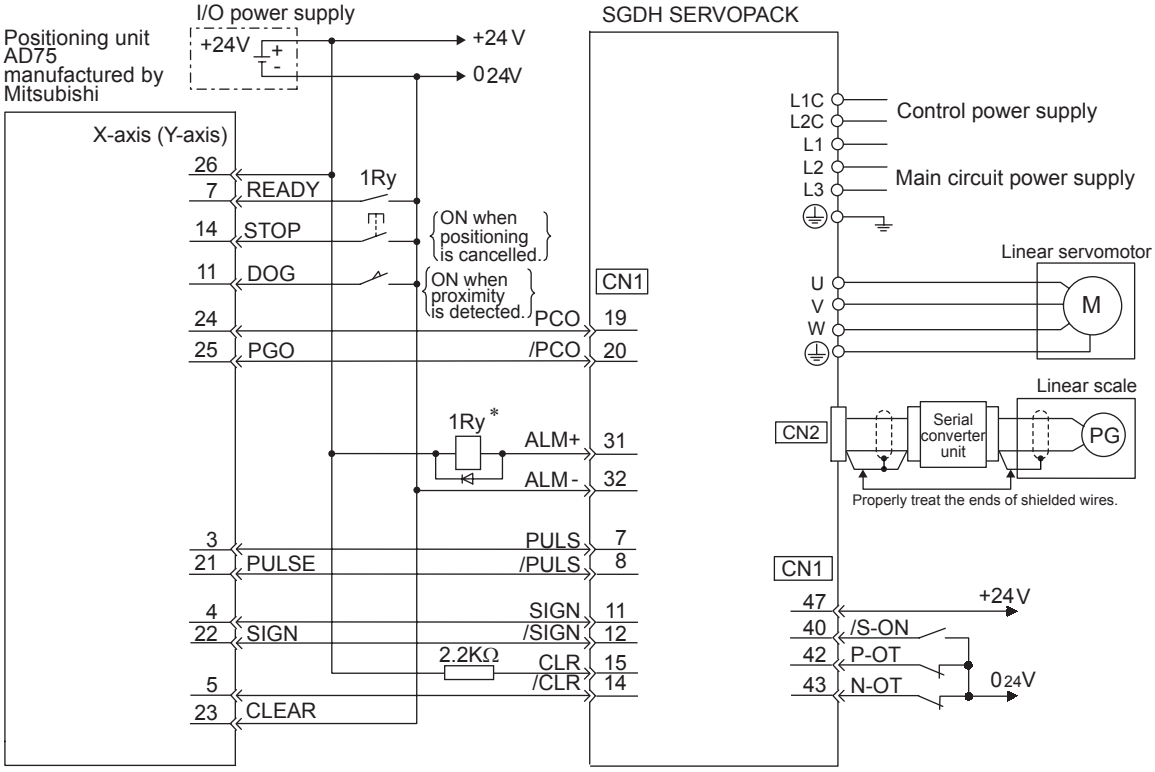
7.3.9 Example of Connection to Mitsubishi's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)



* 1. The ALM signal is output for about two seconds after the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.
* 2. Pin numbers are the same both for X-axis and Y-axis.
* 3. Connect the connector wire to the connector shell.
* 4. represents twisted-pair wires.

Note: Only signals applicable to Mitsubishi's AD72 Positioning Unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

7.3.10 Example of Connection to Mitsubishi's AD75 Positioning Unit (SERVOPACK in Position Control Mode)



* The ALM signal is output for about two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

Note: Only signals applicable to Mitsubishi's AD75 Positioning Unit and Yaskawa's SGDH SERVOPACK are shown in the diagram.

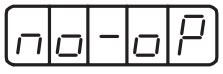
7.4 List of Parameters

7.4.1 Utility Functions List

The following list shows the available utility functions.

Parameter No.	Function	Remarks	Reference Section
Fn000	Alarm traceback data display		3.2.2
Fn001	Rigidity setting during online autotuning	○	5.2.5
Fn002	JOG mode operation	○	3.2.3
Fn003	Zero-point search mode	○	3.2.4
Fn005	Parameter setting initialization	○	3.2.5
Fn006	Alarm traceback data clear	○	3.2.6
Fn007	Writing to EEPROM mass ratio data obtained from online autotuning	○	5.2.7
Fn008	Fixed parameter	○	–
Fn009	Automatic tuning of analog (speed, force) reference offset	○	4.7.3 4.9.3
Fn00A	Manual adjustment of speed reference offset	○	4.7.3
Fn00B	Manual adjustment of force reference offset	○	4.9.3
Fn00C	Manual zero-adjustment of analog monitor output	○	–
Fn00D	Manual gain-adjustment of analog monitor output	○	–
Fn00E	Automatic offset-adjustment of motor current detection signal	○	3.2.7
Fn00F	Manual offset-adjustment of motor current detection signal	○	3.2.8
Fn010	Password setting (protects parameters from being changed)		3.2.9
Fn011	Motor models display		3.2.10
Fn012	Software version display		3.2.11
Fn013	Fixed parameter	○	–
Fn014	Application module detection results clear	○	3.2.12

Note: When the parameters marked with "○" in remarks column are set for Password Setting (Fn010), the indication shown below appears and such parameters cannot be changed.



Blinks for one second

7.4.2 List of Parameters

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn000	Function Selection Basic Switches	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Direction Selection
(Refer to *4.6.2 Switching the Linear Servomotor Movement Direction.*)

0	Sets the linear counting up (phase-A advance) direction as forward direction.
1	Sets the linear counting down (phase-B advance) direction as forward direction. (Movement direction reversal mode)

Control Method Selection
(Refer to *4.5, 4.12*)

0	Speed control (analog reference)
1	Position control (pulse train reference)
2	Force control (analog reference)
3	Internal set speed control (contact reference)
4	Internal set speed control (contact reference) ⇔ Speed control (analog referene)
5	Internal set speed control (contact reference) ⇔ Position control (pulse train reference)
6	Internal set speed control (contact reference) ⇔ Force control (analog reference)
7	Position control (pulse train reference) ⇔ Speed control (analog reference)
8	Position control (pulse train reference) ⇔ Force control (analog reference)
9	Force control (analog reference) ⇔ Speed control (analog reference)
A	Speed control (analog reference) ⇔ Zero clamp
B	Position control (pulse train reference) ⇔ Position control (INHIBIT)

Axis Address

0 to F	Sets SERVOPACK axis address.

Rotation Type/Linear Type Selection (When the Encoder is not Connected)

0	Starts up as rotation type.
1	Starts up as linear type.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn001	Function Selection Application Switches 1	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Servo OFF or Alarm Stop Mode
(Refer to *4.6.4 Selecting the Stopping Method After Servo OFF.*)

0	Stops the linear servomotor by applying dynamic brake (DB).
1	Stops the linear servomotor by applying dynamic brake (DB) and then releases DB.
2	Makes the linear servomotor coast to a stop state without using the dynamic brake (DB).

Overtravel (OT) Stop Mode
(Refer to *4.6.3 Selecting the Overtravel Limit Function.*)

0	Same setting as Pn001.0 (Stops the linear servomotor by applying DB or by coasting).
1	Sets the emergency stop force of Pn406 to the maximum value, decelerate the linear servomotor to a stop, and then sets it to servolock state.
2	Sets the emergency stop force of Pn406 to the maximum value, decelerate the linear servomotor to a stop, and then sets it to coasting state.

AC/DC Power Input Selection

0	Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.
1	Applicable to DC power input: Input DC power supply between ⊕1 and ⊖.

Warning Code Output Selection
(Refer to *4.13.2 Warning Display.*)

0	ALO1, ALO2, and ALO3 output only alarm codes.
1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).

Pn002	Function Selection Application Switches 2	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Speed Control Option (T-REF Terminal Allocation)

0	N/A
1	Uses T-REF as an external force limit input. (Refer to 4.11.3)
2	Uses T-REF as a force feed forward input. (Refer to 5.4.2)
3	Use T-REF as an external force limit input when P-CL and N-CL are ON. (Refer to 4.11.4)

Force Control Option (V-REF Terminal Allocation)
(Refer to *4.9.4*)

0	N/A
1	Uses V-REF as an external speed limit input.

Reserved (Do not change)

Reserved (Do not change)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn003	Function Selection Application Switches 3	–	–	0002	Immedi-ately	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Analog Monitor 1 / Analog Monitor 2 Signals (Refer to *5.5 Analog Monitor*.)

00	Motor speed: 1V/1000 mm/s
01	Speed reference: 1V/1000 mm/s
02	Force reference: 1V/100%
03	Position error: 0.05V/1 reference unit
04	Position error: 0.05V/100 reference units
05	Reference pulse frequency: 1V/1000 mm/s
06	Motor speed × 4: 1V/250 mm/s
07	Motor speed × 8: 1V/125 mm/s

Reserved (Do not change) (Refer to 5.5 Analog Monitor.)

Reserved (Do not change)

Pn004	Reserved (Do not change)	–	–	0000	Immedi-ately	–
Pn005	Reserved (Do not change)	–	–	0000	Immedi-ately	–
Pn080	Function Selection Application Switches 80	–	–	0000	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Hall Sensor Selection (Refer to *4.2.3*)

0	With hall sensor
1	Without hall sensor

Motor Phase Order Selection*1 (Refer to *4.2.2, 4.2.3*)

0	Phase A progression in order of phase U, V, and W
1	Phase B progression in order of phase U, V, and W

Reserved (Do not change)

Calculation of Motor Max. Speed and Encoder Output Resolution Max. Value Selection*2

0	Calculates the encoder output resolution max. value by fixing the motor max. speed.
1	Calculates the motor max. speed by fixing the encoder output resolution max. value.

* 1. If the linear servomotor with a hall sensor is used, software version 32 or later can be used. If software version earlier than 32 is used, set to zero.
* 2. Available only for the software version 32 or later.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn100	Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	5.3.4
Pn101	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immedi-ately	5.3.5
Pn102	Position Loop Gain	1 to 2000	1/s	40	Immedi-ately	5.3.3
Pn103	Mass Ratio	0 to 10000 (0 to 20000)*1	1%	0	Immedi-ately	4.2.2 4.2.3 5.2.6
Pn104	2nd Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	5.4.9
Pn105	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	20.00	Immedi-ately	5.4.9
Pn106	2nd Position Loop Gain	1 to 2000	1/s	40	Immedi-ately	5.4.9
Pn108	Bias Width Addition	0 to 250	1 reference unit	7	Immedi-ately	5.4.6
Pn109	Feed-forward	0 to 100	1%	0	Immedi-ately	5.4.1
Pn10A	Feed-forward Filter Time Constant	0 to 6400	0.01 ms	0	Immedi-ately	5.4.1
Pn10B	Gain-related Application Switches	–	–	0000	After restart / Immedi-ately	–
Pn10C	Mode Switch Force Reference	0 to 800	1%	200	Immedi-ately	5.4.5

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Mode Switch Selection (Refer to *5.4.5 Using the Mode Switch (P/PI Switching.)*) — Setting Validation: Immediately

0	Use internal force reference as the condition. (Level setting: Pn10C)
1	Use speed reference as the condition. (Level setting: Pn181)
2	Use acceleration as the condition. (Level setting: Pn182)
3	Use position error pulse as the condition. (Level setting: Pn10F)
4	No mode switch function available

Speed Loop Control Method (Refer to *5.3.5 Speed Loop Integral Time Constant.*) — Setting Validation: After restart

0	PI control
1	I-P control

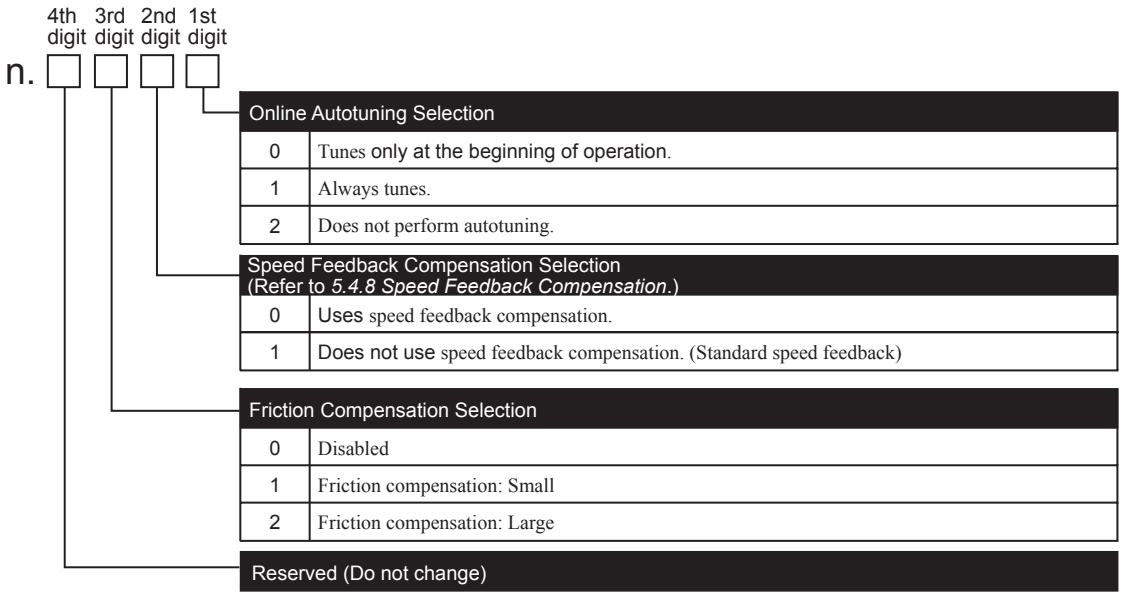
Automatic Gain Switching Selection *2 (Refer to *5.4.11*)*2 — Setting Validation: After restart

0	No automatic gain switching available
1	Position reference
2	Position error
3	Both position reference and position error

Reserved (Do not change)

* 1. The setting range for the software version 32 or later
* 2. Available only for the software version 32 or later

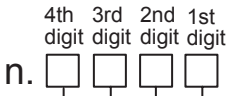
Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn10F	Mode Switch Position Error Pulse	0 to 10000	1 reference unit	0	Immedi-ately	5.4.5
Pn110	Online Autotuning Switches	–	–	0010	After restart	–



Pn111	Speed Feedback Compensation *1	1 to 500	1%	100	Immedi-ately	5.4.8
Pn124	Automatic Gain Switching Timer *2	1 to 10000	1 ms	100	Immedi-ately	–
Pn125	Automatic Gain Switching Width *2	1 to 250	1 reference unit	7	Immedi-ately	–
Pn180	Bias	0 to 450	1 mm/s	0	Immedi-ately	5.4.6
Pn181	Mode Switch Speed Reference	0 to 5000	1 mm/s	0	Immedi-ately	5.4.5
Pn182	Mode Switch Acceleration	0 to 30000	1 mm/s^2	0	Immedi-ately	5.4.5

* 1. Pn111 will be effective when Pn110.1 is set "0."
* 2. Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn200	Position Control Reference Form Selection Switch	–	–	0000	After restart	4.8.1



Reference Pulse Form

0	Sign + Pulse, positive logic
1	CW + CCW, positive logic
2	Phase A + Phase B (×1), positive logic
3	Phase A + Phase B (×2), positive logic
4	Phase A + Phase B (×4), positive logic
5	Sign + Pulse, negative logic
6	CW + CCW, negative logic
7	Phase A + Phase B (×1), negative logic
8	Phase A + Phase B (×2), negative logic
9	Phase A + Phase B (×4), negative logic

Position Error Counter Clear Signal Form

0	Clears position error counter when the signal is at H level.
1	Clears position error counter at the rising edge of the signal.
2	Clears position error counter when the signal is at L level.
3	Clears position error counter at the falling edge of the signal.

Clear Operation

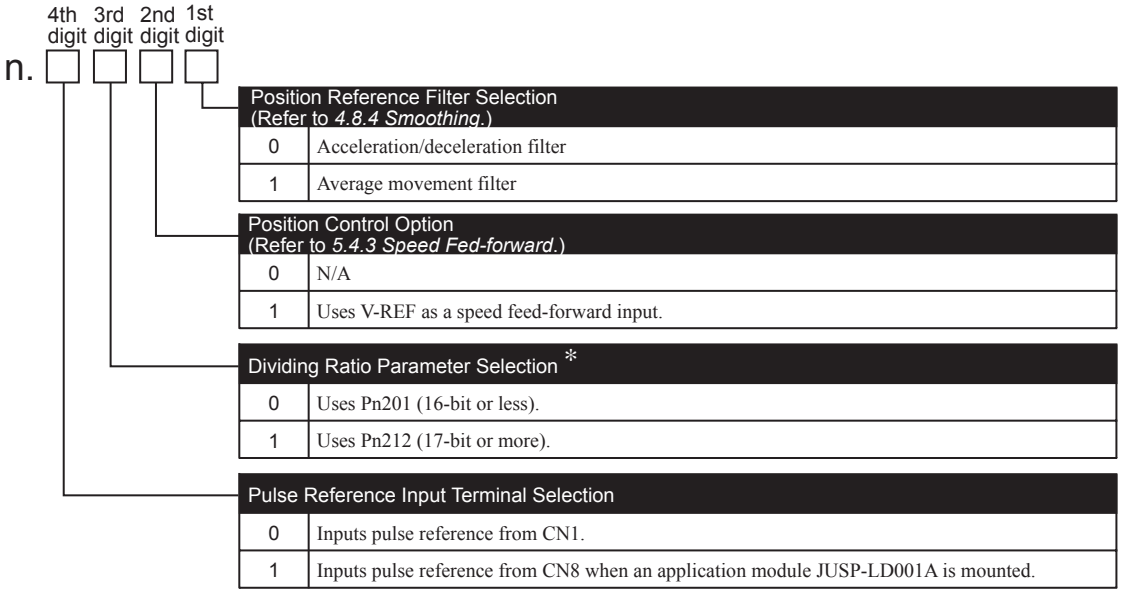
0	Clear error counter at the baseblock.
1	Does not clear error counter. (Possible to clear error counter only with CLR signal.)
2	Clear error counter when an alarm occurs.

Filter Selection

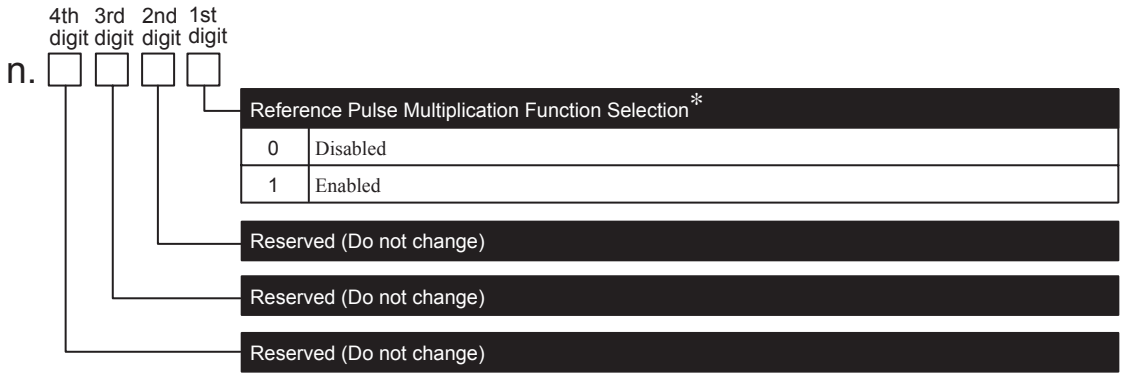
0	Reference input filter for line driver signals
1	Reference input filter for open collector signals

Pn202	Electronic Gear Ratio (Numerator)	1 to 65535	–	4	After restart	4.8.2
Pn203	Electronic Gear Ratio (Denominator)	1 to 65535	–	1	After restart	4.8.2
Pn204	Position Reference Accel/Decel Time Constant	0 to 6400	0.01 ms	0	Immedi-ately	4.8.4

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn207	Position Control Function Switches	–	–	0000	After restart	–
Pn208	Position Reference Movement Averaging Time	0 to 6400	0.01 ms	0	After restart	4.8.4

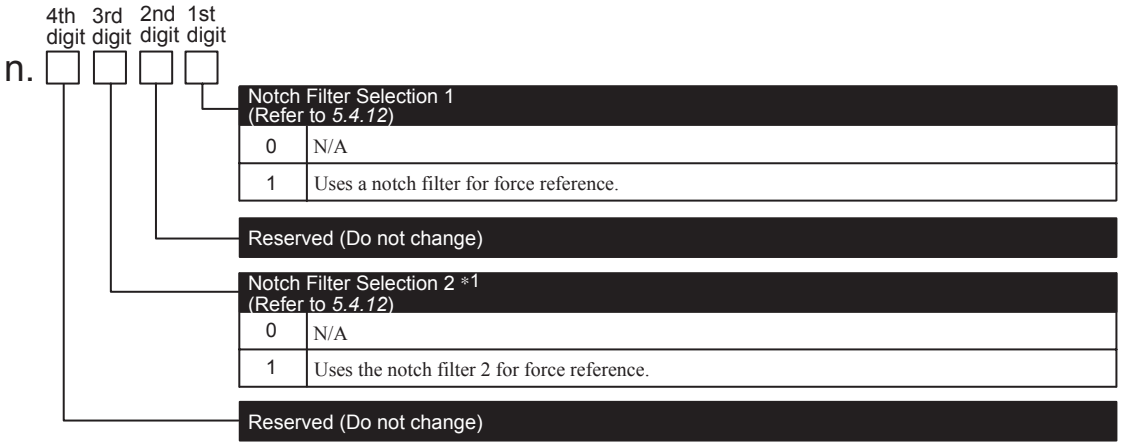

4th digit
3rd digit
2nd digit
1st digit
n.
Position Reference Filter Selection
(Refer to 4.8.4 Smoothing.)
0 Acceleration/deceleration filter
1 Average movement filter
Position Control Option
(Refer to 5.4.3 Speed Fed-forward.)
0 N/A
1 Uses V-REF as a speed feed-forward input.
Dividing Ratio Parameter Selection *
0 Uses Pn201 (16-bit or less).
1 Uses Pn212 (17-bit or more).
Pulse Reference Input Terminal Selection
0 Inputs pulse reference from CN1.
1 Inputs pulse reference from CN8 when an application module JUSP-LD001A is mounted.

* Available only for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn217	Reference Pulse Input Multiplication *	1 to 99	× 1	1	Immedi-ately	–
Pn218	Reference Pulse Input Multiplication Function Selection *	–	–	0000	After restart	–
						
Pn280	Linear Scale Pitch	0 to 65535	1 µm	0	After restart	4.2.2 4.2.3 4.7.7 4.8.2
Pn281	PG Divider	1 to 255	1P/(scale pitch)	20	After restart	4.7.7
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immeci-ately	4.7.1 4.9.4
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immedi-ately	4.7.4
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immedi-ately	4.7.4
Pn307	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immedi-ately	4.7.5
Pn308	Speed Feedback Filter Time Constant	0 to 65535	0.01 ms	0	Immedi-ately	5.4.7
Pn380	Internal Set Speed 1	0 to 5000	1 mm/s	10	Immedi-ately	4.10.1
Pn381	Internal Set Speed 2	0 to 5000	1 mm/s	20	Immedi-ately	4.10.1
Pn382	Internal Set Speed 3	0 to 5000	1 mm/s	30	Immedi-ately	4.10.1
Pn383	JOG Speed	0 to 5000	1 mm/s	50	Immedi-ately	–
Pn384	Motor Maximum Speed *	1 to 100	0.1 m/s	50	After restart	4.6.6
Pn400	Force Reference Input Gain	10 to 50	0.1 V/ rated force	30	Immedi-ately	4.9.1 4.9.2 5.4.2
Pn401	Force Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immedi-ately	5.4.10
Pn404	Forward External Force Limit	0 to 800	1%	100	Immedi-ately	4.11.2 4.11.4
Pn405	Reverse External Force Limit	0 to 800	1%	100	Immedi-ately	–

* Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn406	Emergency Stop Force	0 to 800	1%	800	Immedi-ately	4.6.3
Pn408	Force Function Switches	–	–	0000	Immedi-ately	–
Pn409	Notch Filter Frequency	50 to 2000	1 Hz	2000	Immedi-ately	5.4.10
Pn40A	Notch Filter Q Value *1	50 to 400	0.01	70	Immedi-ately	5.4.10
Pn40B	Notch Filter 2 Frequency *1	50 to 2000	1 Hz	2000	Immedi-ately	5.4.10
Pn40C	Notch Filter 2 Q Value *1	50 to 400	0.01	70	Immedi-ately	5.4.10
Pn480	Speed Limit during Force Control	0 to 5000	1 mm/s	5000	Immedi-ately	4.9.4
Pn481	Polarity Detection Speed Loop Gain	1 to 2000	1 Hz	40	Immedi-ately	4.2.3
Pn482	Polarity Detection Speed Loop Integral Time Constant	15 to 51200	0.01 ms	3000	Immedi-ately	4.2.3
Pn483	Forward Force Limit *2	0 to 800	1 %	30	Immedi-ately	4.2.3 4.11.1
Pn484	Reverse Force Limit *2	0 to 800	1 %	30	Immedi-ately	
Pn500	Positioning Completed Width	0 to 250	1 reference unit	7	Immedi-ately	4.8.5
Pn504	NEAR Signal Width	1 to 250	1 reference unit	7	Immedi-ately	4.8.6
Pn505	Overflow Level	256 to 8388352	256 refer-ence units	262144	Immedi-ately	5.3.3
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immedi-ately	–
Pn508	Servo OFF - Brake Reference Waiting Time	10 to 100	10 ms	500	Immedi-ately	–
Pn509	Momentary Hold Time	20 to 1000	1 ms	20	Immedi-ately	4.6.5


4th digit
3rd digit
2nd digit
1st digit
n.
Notch Filter Selection 1 (Refer to 5.4.12)
0 N/A
1 Uses a notch filter for force reference.
Reserved (Do not change)
Notch Filter Selection 2 *1 (Refer to 5.4.12)
0 N/A
1 Uses the notch filter 2 for force reference.
Reserved (Do not change)

* 1. Available for the software version 32 or later
* 2. To reduce any danger while setting up the linear servomotor, the factory settings are set to low values (factory setting: 30%). After the servomotor has been set up, increase the settings of the parameters to the required force. For details, refer to *4.2 Trial Operation Using SERVOPACK Internal References*.

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50A	Input Signal Selection 1	–	–	2100	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Input Signal Allocation Mode
(Refer to 3.3.2 Input Circuit Signal Allocation.)

0	Uses the sequence input signal terminals with standard allocation.
1	Changes the sequence input signal allocation for each signal.

/S-ON Signal Mapping
Signal Polarity: Normal: Servo ON when ON (L-level)
Signal Polarity: Reverse: Servo ON when OFF (H-level)
(Refer to *4.6.1 Setting the Servo ON Signal*.)

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	OFF when CN1-40 input signal is OFF (H-level)
A	OFF when CN1-41 input signal is OFF (H-level)
B	OFF when CN1-42 input signal is OFF (H-level)
C	OFF when CN1-43 input signal is OFF (H-level)
D	OFF when CN1-44 input signal is OFF (H-level)
E	OFF when CN1-45 input signal is OFF (H-level)
F	OFF when CN1-46 input signal is OFF (H-level)

/P-CON Signal Mapping (P control when ON (L-level))
Refer to *5.4.4 Proportional Control Operation (Proportional Operation Reference)*.)

0 to F	Same as /S-ON

P-OT Signal Mapping (Forward run prohibited when OFF (H-level))
Refer to *4.6.3 Setting the Overtravel Limit Function*.)

0	Forward run allowed when CN1-40 input signal is ON (L-level)
1	Forward run allowed when CN1-41 input signal is ON (L-level)
2	Forward run allowed when CN1-42 input signal is ON (L-level)
3	Forward run allowed when CN1-43 input signal is ON (L-level)
4	Forward run allowed when CN1-44 input signal is ON (L-level)
5	Forward run allowed when CN1-45 input signal is ON (L-level)
6	Forward run allowed when CN1-46 input signal is ON (L-level)
7	Forward run prohibited
8	Forward run allowed
9	Forward run allowed when CN1-40 input signal is OFF (H-level)
A	Forward run allowed when CN1-41 input signal is OFF (H-level)
B	Forward run allowed when CN1-42 input signal is OFF (H-level)
C	Forward run allowed when CN1-43 input signal is OFF (H-level)
D	Forward run allowed when CN1-44 input signal is OFF (H-level)
E	Forward run allowed when CN1-45 input signal is OFF (H-level)
F	Forward run allowed when CN1-46 input signal is OFF (H-level)

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50B	Input Signal Selection 2	–	–	6543	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

N-OT Signal Mapping (Reverse run prohibited when OFF (H-level)
Refer to *4.6.3 Setting the Overtravel Limit Function*.)

0	Reverse run allowed when CN1-40 input signal is ON (L-level)
1	Reverse run allowed when CN1-41 input signal is ON (L-level)
2	Reverse run allowed when CN1-42 input signal is ON (L-level)
3	Reverse run allowed when CN1-43 input signal is ON (L-level)
4	Reverse run allowed when CN1-44 input signal is ON (L-level)
5	Reverse run allowed when CN1-45 input signal is ON (L-level)
6	Reverse run allowed when CN1-46 input signal is ON (L-level)
7	Reverse run prohibited
8	Reverse run allowed
9	Reverse run allowed when CN1-40 input signal is OFF (H-level)
A	Reverse run allowed when CN1-41 input signal is OFF (H-level)
B	Reverse run allowed when CN1-42 input signal is OFF (H-level)
C	Reverse run allowed when CN1-43 input signal is OFF (H-level)
D	Reverse run allowed when CN1-44 input signal is OFF (H-level)
E	Reverse run allowed when CN1-45 input signal is OFF (H-level)
F	Reverse run allowed when CN1-46 input signal is OFF (H-level)

/ALM-RST Signal Mapping (Alarm Reset when ON (L-level)
(Refer to *4.13.1 Servo Alarm Output (ALM) and Alarm Code Output (ALO1, ALO2, ALO3)*.)

0 to 6	Same as /S-ON, the setting of 2nd digit of Pn50.A
7	Reserved (Do not change)
8 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

/P-CL Signal Mapping (Force Limit when ON (L-level))
(Refer to *4.10.2, 4.10.3, 4.11.2, and 4.11.4*.)

0 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

/N-CL Signal Mapping (Force Limit when ON (L-level))
Refer to 4.10.2, 4.10.3, 4.11.2, and 4.11.4.)

0 to F	Same as /S-ON, the setting of 2nd digit of Pn50.A

INFO

■ Input signal polarities

Signal	Effective Level	Voltage Level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50C	Input Signal Selection 3	–	–	8888	After restart	–

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

/SPD-D Signal Mapping
(Refer to *4.10 Operating Using Speed Control with an Internally Set Speed*.)

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	ON when CN1-40 input signal is OFF (H-level)
A	ON when CN1-41 input signal is OFF (H-level)
B	ON when CN1-42 input signal is OFF (H-level)
C	ON when CN1-43 input signal is OFF (H-level)
D	ON when CN1-44 input signal is OFF (H-level)
E	ON when CN1-45 input signal is OFF (H-level)
F	ON when CN1-46 input signal is OFF (H-level)

/SPD-A Signal Mapping
(Refer to *4.10 Operating Using Speed Control with an Internally Set Speed*.)

0 to F	Same as /SPD-D

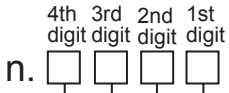
/SPD-B Signal Mapping
(Refer to *4.10 Operating Using Speed Conttol with an Internally Set Speed*.)

0 to F	Same as /SPD-D

/C-SEL Signal Mapping (Control mode change when ON (L-level))
(Refer to *4.12.2 Switching the Control Mode*.)

0 to F	Same as /SPD-D

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50D	Input Signal Selection 4	–	–	8888	After restart	–



/ZCLAMP Signal Mapping (Zero clamp when ON (L-level))
(Refer to *4.7.6 Using the Zero Camp Function*.)

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	ON when CN1-40 input signal is OFF (H-level)
A	ON when CN1-41 input signal is OFF (H-level)
B	ON when CN1-42 input signal is OFF (H-level)
C	ON when CN1-43 input signal is OFF (H-level)
D	ON when CN1-44 input signal is OFF (H-level)
E	ON when CN1-45 input signal is OFF (H-level)
F	ON when CN1-46 input signal is OFF (H-level)

/INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level))
(Refer to *4.8.7 Reference Pulse Inhibit function (INHIBIT)*.)

0 to F	Same as /ZCLAMP

/G-SEL1 Signal Mapping (Gain change when ON (L-level))
(Refer to *5.4.9 Switching Gain Settings*.)

0 to F	Same as /ZCLAMP

/P-DET Signal Mapping (Polarity detection when ON (L-level))
(Refer to *4.2.3*)

0 to F	Same as /ZCLAMP

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn50E	Output Signal Selection 1	–	–	3211	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Positioning Completion Signal Mapping (/COIN)
(Refer to *4.8.5 Positioning Completed Output Signal*.)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 output terminal.
2	Outputs the signal from CN1-27, -28 output terminal.
3	Outputs the signal from CN1-29, -30 output terminal.

Speed Coincidence Detection Signal Mapping (/V-CMP)
(Refer to *4.7.8 Speed Coincidence Output*.)

0 to 3	Same as /COIN

Movement Detection Signal Mapping (/TGON) *(Refer to 4.13.3)*

0 to 3	Same as /COIN

Servo Ready Signal Mapping (/S-RDY)
(Refer to 4.13.4 Servo Ready (/S-RDY) Output.)

0 to 3	Same as /COIN

Pn50F	Output Signal Selection 2	–	–	0000	After restart	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

Force Limit Detection Signal Mapping (/CLT)
(Refer to *4.11.5 Checking Output Force Limiting during Operation*.)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 output terminal.
2	Outputs the signal from CN1-27, -28 output terminal.
3	Outputs the signal from CN1-29, -30 output terminal.

Speed Limit Detection Signal Mapping (/VLT)
(Refer to *4.9.4 Limiting Linear Servomotor Speed during Force Control*.)

0 to 3	Same as /CLT

Brake Interlock Signal Mapping (/BK)
(Refer to *3.3.3 Setting for Holding Brakes*.)

0 to 3	Same as /CLT

Warning Signal Mapping (/WARN)
(Refer to *4.13.2 Warning Output (/WARN)*.)

0 to 3	Same as /CLT

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn510	Output Signal Selection 3	–	–	0000	After restart	4.8.6

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Near Signal Mapping (/NEAR)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 terminal.
2	Outputs the signal from CN1-27, -28 terminal.
3	Outputs the signal from CN1-29, -30 terminal.

Reserved (Do not change)

Reference Pulse Input Switch Signal Mapping (/P-SELA)*

0 to 3	Same as /NEAR

Reserved (Do not change)

Pn512	Output Signal Reverse Settings	–	–	0000	After restart	3.3.3

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Output Signal Reverse for CN1-25 or -26 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

Output Signal Reverse for CN1-27 or -28 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

Output Signal Reverse for CN1-29 or -30 Terminals

0	Output signal is not reversed.
1	Output signal is reversed.

Reserved (Do not change)

* Available for the software version 32 or later

Parameter No.	Name	Setting Range	Unit	Factory Setting	Setting Validation	Reference Section
Pn513	Input Signal Selection 5 *1	–	–	0000	After restart	3.3.2

n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

/P-SEL2 Signal Mapping (Gain change when ON (L-level))

0	ON when CN1-40 input signal is ON (L-level)
1	ON when CN1-41 input signal is ON (L-level)
2	ON when CN1-42 input signal is ON (L-level)
3	ON when CN1-43 input signal is ON (L-level)
4	ON when CN1-44 input signal is ON (L-level)
5	ON when CN1-45 input signal is ON (L-level)
6	ON when CN1-46 input signal is ON (L-level)
7	Sets signal ON.
8	Sets signal OFF.
9	ON when CN1-40 input signal is OFF (H-level)
A	ON when CN1-41 input signal is OFF (H-level)
B	ON when CN1-42 input signal is OFF (H-level)
C	ON when CN1-43 input signal is OFF (H-level)
D	ON when CN1-44 input signal is OFF (H-level)
E	ON when CN1-45 input signal is OFF (H-level)
F	ON when CN1-46 input signal is OFF (H-level)

Reserved (Do not change)

Reserved (Do not change)

Reserved (Do not change)

Pn51E	Excessive Position Error Warning Level *1	0 to 100	1%	0	Immedi-ately	6.1.2
Pn580	Zero Clamp Level	0 to 5000	1 mm/s	10	Immedi-ately	4.7.6
Pn581	Zero Speed Level	1 to 5000	1 mm/s	20	Immedi-ately	4.13.3
Pn582	Speed Coincidence Signal Output Width	0 to 100	1 mm/s	10	Immedi-ately	4.7.8
Pn583	Brake Reference Output Speed Level	0 to 5000	1 mm/s	100	Immedi-ately	–
Pn584	Motor Self-cooling Ratio*1	0 to 100	1% / peak speed	0	Immedi-ately	–
Pn600	External Regenerative Resistor Capacity*2	Depending on model*3	10 W	0	Immedi-ately	

* 1. Avaiable for the software version 32 or later
* 2. Normally set to “0.” When an external regenerative resistor is mounted, set the value of external regenerative resistor capacity (W).
* 3. The upper limit value is the maximum output capacity (W) of applied SERVOPACK.

7.4.3 Monitor Modes

The following list shows available monitor modes.

Parameter No.	Content of Display	Unit
Un000	Actual motor speed	mm/s
Un001	Input speed reference	mm/s
Un002	Internal force reference (Value for rated force)	%
Un003*1	Electrical angle 1 (32-bit decimal code)	number of pulses from the phase-C (zero point)
Un004	Electrical angle 2 (Angle from 0 (zero) degree of phase-U)	deg
Un005	Input signal monitor	–
Un006	Output signal monitor	–
Un007	Input reference pulse speed (displayed only in position control mode)	mm/s
Un008	Error counter (amount of position error) (displayed only in position control mode)	reference unit
Un009	Accumulated load rate (Value for the rated force as 100%: Displays effective force in 10 s cycle.)	%
Un00A	Regenerative load rate (Value for the processable regenerative power as 100%: Displays regenerative power consumption in 10 s cycle.)	%
Un00B	Power consumed by DB resistance (Value for the processable power when dynamic brake is applied as 100%: Displays DB power consumption in 10 s cycle.)	%
Un00C	Input reference pulse counter (32-bit decimal code) (displayed only in position control mode)	–
Un00D	Feedback pulse counter (32-bit decimal code)	–
Un010*2	Motor maximum speed setting upper limit or encoder output resolution setting upper limit	100mm/s or Pulse/scale pitch (Pn280)
Un011*2	Hall sensor signal monitor	–

* 1. Cannot be used if there is no zero point on the linear scale.
* 2. Available for the software version 32 or later

7.5 Parameter Recording Table

Use the following table for recording parameters.

Note: Setting validation ("immediately" or "after restart") for Pn10B and Pn110 differs depending on the digit. The digits validated after restart are underlined in "Factory Setting" column.

Parameter	Factory Setting						Name	Setting Validation
Pn000	0000						Function Selection Basic Switches 0	After restart
Pn001	0000						Function Selection Application Switches 1	After restart
Pn002	0000						Function Selection Application Switches 2	After restart
Pn003	0002						Function Selection Application Switches 3	Immediately
Pn080	0000						Function Selection Application Switches 80	After restart
Pn100	40 Hz						Speed Loop Gain	Immediately
Pn101	20.00 ms						Speed Loop Integral Time Constant	Immediately
Pn102	40/s						Position Loop Gain	Immediately
Pn103	0 %						Mass Ratio	Immediately
Pn104	40 Hz						2nd Speed Loop Gain	Immediately
Pn105	20.00 ms						2nd Speed Loop Integral Time Constant	Immediately
Pn106	40/s						2nd Position Loop Gain	Immediately
Pn108	7 reference units						Bias Width Addition	Immediately
Pn109	0 %						Feed-forward	Immediately
Pn10A	0.00 ms						Feed-forward Filter Time Constant	Immediately
Pn10B	0000						Gain-related Application Switches	After restart
Pn10C	200 %						Mode Switch Force Reference	Immediately
Pn10F	0 reference unit						Mode Switch Error Pulse	Immediately
Pn110	0010						Online Autotuning Switches	After restart
Pn111	100 %						Speed Feedback Compensation	Immediately
Pn124	100 ms						Automatic Gain Change Timer	Immediately
Pn125	7						Automatic Gain Change Width	Immediately
Pn180	0 mm/s						Bias	Immediately
Pn181	0 mm/s						Mode Switch Speed Reference	Immediately
Pn182	0 mm/s^2						Mode Switch Acceleration	Immediately
Pn200	0000						Position Control References Form Selection Switches	After restart

Parameter	Factory Setting						Name	Setting Validation
Pn202	4						Electronic Gear Ratio (Numerator)	After restart
Pn203	1						Electronic Gear Raio (Denominator)	After restart
Pn204	0 ms						Position Reference Accel/Decel Time Constant	Immediately
Pn207	0000						Position Control Function Switches	After restart
Pn208	0 ms						Position Reference Movement Average Time	Immediately
Pn217	1						Reference Pulse Input Multiplication	Immediately
Pn218	0000						Reference Pulse Input Multiplication Function Selection	After restart
Pn280	0 μm						Linear Scale Pitch	After restart
Pn281	20						PG Divider	After restart
Pn300	6.00 V/rated speed						Speed Reference Input Gain	Immediately
Pn305	0 ms						Soft Start Acceleration Time	Immediately
Pn306	0 ms						Soft Start Deceleration Time	Immediately
Pn307	0.40 ms						Speed Reference Filter Time Constant	Immediately
Pn308	0.00 ms						Speed Feedback Filter Time Constant	Immediately
Pn380	10 mm/s						Internal Set Speed 1	Immediately
Pn381	20 mm/s						Internal Set Speed 2	Immediately
Pn382	30 mm/s						Internal Set Speed 3	Immediately
Pn383	50 mm/s						JOG Speed	Immediately
Pn384	5.0m/s						Motor Maximum Speed	After restart
Pn400	3.0 V/rated force						Force Reference Input Gain	Immediately
Pn401	1.00 ms						Force Reference Filter Time Constant	Immediately
Pn404	100 %						Forward External Force Limit	Immediately
Pn405	100 %						Reverse External Force Limit	Immediately
Pn406	800 %						Emergency Stop Force	Immediately
Pn408	0000						Force Function Switches	Immediately
Pn409	2000 Hz						Notch Filter Frequency	Immediately
Pn40A	0.70						Notch Filter Q Value	Immediately
Pn40B	2000 Hz						Notch Filter 2 Frequency	Immediately
Pn40C	0.70						Notch Filter 2 Q Value	Immediately
Pn480	5000mm/s						Speed Limit in Force Control	Immediately

Parame-ter	Factory Setting						Name	Setting Valida-tion
Pn481	40 Hz						Polarity Detection Speed Loop Gain	Imme-diately
Pn482	30.00 ms						Polarity Detection Speed Loop Integral Time Constant	Imme-diately
Pn483	30 %						Forward Force Limit	Imme-diately
Pn484	30 %						Reverse Force Limit	Imme-diately
Pn500	7						Position Completion Width	Imme-diately
Pn504	7						Near Signal Width	Imme-diately
Pn505	262144						Overflow Level	
Pn506	0 ms						Brake Reference - Servo OFF Delay Time	Imme-diately
Pn508	500 ms						Servo OFF - Brake Reference Waiting Time	Imme-diately
Pn509	20 ms						Momentary Hold Time	Imme-diately
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn512	0000						Output Signal Reverse Settings	After restart
Pn513	8888						Input Signal Selection 5	After restart
Pn51E	0%						Excessive Position Error Warning Level	Imme-diately
Pn580	10 mm/s						Zero Clamp Level	Imme-diately
Pn581	20 mm/s						Zero Speed Level	Imme-diately
Pn582	10 mm/s						Speed Coincidence Signal Output Width	Imme-diately
Pn583	100mm/s						Brake Reference Output Speed Level	Imme-diately
Pn584	0% /max. speed						Motor Self-cooling Ratio	Imme-diately
Pn600	0 W						External Regenrative Resistor Capacity	Imme-diately

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